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1.0 INTRODUCTION

1.1 PURPOSE

This Closure Plan was prepared for the Land Treatment Facility (landfarm) at the UNO-VEN refinery, Lemont, Illinois. Pursuant to 35 Illinois Administrative Code (IAC) Section 725.212, the Closure Plan addresses the following elements:

- how the landfarm will be closed to meet the general closure performance standards (35 IAC Section 725.212(b)(1));
- provides an estimate of the maximum volume of hazardous waste managed during the active life of the facility, including the methods for closure (35 IAC Section 725.212(b)(3));
- decontamination and sampling procedures (35 IAC Section 725.212(b)(4));
- other closure activities, including ground-water monitoring and run-on and run-off control (35 IAC Section 725.212(b)(5)); and
- schedule for closure (35 IAC Section 725.212(b)(6)).

The landfarm is the only unit regulated under the Resource Conservation and Recovery Act (RCRA) that is covered by this Closure Plan.

1.2 SITE DESCRIPTION

1.2.1 Site Location

The UNO-VEN refinery (IL D0041550567) is located at 135th Street and New Avenue in Lemont, Will County, Illinois, about 25 miles southwest of downtown Chicago and 2 miles southwest of Lemont, Illinois. The refinery is bounded to the west and north by the Illinois and Michigan Canal, to the east by Smith Road, and to the south by 135th Street. The landfarm is bounded by the UNO-VEN refinery tank farm to the north, farm fields to the east and south, and undeveloped land to the west. The landfarm is within the SW ¼ of the NE ¼ of Section 36, Township 37N, Range 10E. Figure 1-1 shows the location of the site on the U.S. Geological Survey topographic map.

1.2.2 Description of Industry

The UNO-VEN refinery has a rated capacity of about 154,000 barrels per day, and produces a number of products, including gasoline, furnace oils, jet fuel, diesel fuel, specialty naphthas, and petroleum coke (ERM, 1988). Unocal operated the refinery until 1989, at which time UNO-VEN was formed through a joint venture between Unocal and Petroleus de Venezuela, SA (PDVSA). The Standard Industrial Classification (SIC) code for the refinery is 2911 (petroleum refining).

1.2.3 Description of Landfarming Operation

The landfarm consists of four discrete plots (referred to as Areas I through IV) used for waste disposal (Figure 1-2). Area I opened in 1973 and Areas II, III, and IV opened in 1981. The landfarm is located within an area that occupies approximately 28 acres, of which about 13.5 acres was used for waste application. The remaining land includes untilled buffer zones around each landfarm plot, roads, and a non-hazardous waste storage and decant basin. The approximate area of each plot is as follows:

Area	Size (acres)
I	5.5
II	4.2
III	1.2
IV	2.6
Total	13.5

Surface water drainage is generally to the west via a drainage ditch that ultimately leads to the stormwater retention ponds at the UNO-VEN refinery, located about 1 mile west of the landfarm.

Between 1973 and 1981, wastes were typically placed into the decant basin located on the east side of the landfarm to reduce the water content of the waste. Direct application of waste materials onto the plots was also performed. Waste materials were most recently applied at the landfarm in December 1989.

The general waste types disposed at the landfarm included the following:

Waste	Source
Water and Wastewater Sludge	Centrifuge at Water and Wastewater Treatment Plant
Stormwater Pond Dredgings	East and West Stormwater Holding Basins
Clear Well Sludge	Water Treatment Unit 41 (Clear Well)
Cooling Tower Sludge	North Plant, Needle Coker, South Plant and Alkylation Unit Cooling Towers
API Separator Sludge	API Separator
Heavy Oil Sludge	Tank 89

The clear well sludge, cooling tower sludge, and heavy oil sludge waste streams were generated once every 3 to 5 years. The chemical characteristics of the waste materials applied at the landfarm are discussed in detail in Section 3.1.

1.3 REGULATORY STATUS

Unocal (formerly Union Oil Company of California) originally opened the landfarm in 1973. API separator sludge (hazardous waste code K051) was treated at the landfarm until September 1981, after which only non-hazardous waste was applied. Unocal submitted a revised RCRA Part A permit application (Appendix A) dated July 13, 1984 to the U.S. Environmental Protection Agency (USEPA) with the complete RCRA Part B Permit application. Unocal and UNO-VEN operated the landfarm under RCRA interim status until the last shipment of waste was applied in December 1989. Since then, Unocal and UNO-VEN have continued to monitor the shallow and deep ground water in the vicinity of the landfarm.

Specifics of a ground-water detection monitoring program for the landfarm were detailed in Section E-3d of the Part B Permit application. Pursuant to 35 IAC Subpart F (Groundwater Monitoring), implementation of a ground-water detection monitoring plan was required for the following parameters:

Appendix III Constituents:
- 2,4,5-TP Silvex;
- radium;
- gross alpha;
- gross beta;
- turbidity (surface water supplies);
- coliform bacteria;

Ground-Water Quality Constituents:
- chloride;
- iron;
- manganese;
- phenols;

- sodium;
- sulfate;

Ground-Water Contamination Indicator Constituents:
- pH;
- specific conductance;
- total organic carbon (TOC); and
- total organic halogen (TOX).

After establishing background ground-water concentrations, sampling is required annually for ground-water quality constituents and semi-annually for ground-water contamination indicator constituents. If it is determined that a statistically significant increase in ground-water contamination indicator parameters has occurred, and it is verified through additional samples, a ground-water assessment monitoring program must be implemented.

The ground-water monitoring program for the landfarm has evolved over the years as a result of seasonal changes in ground-water quality and agency requirements. In the Part B Permit application (Section E), the proposed monitoring system consisted of seven lysimeters, four near-surface soil core samplers, and six monitoring wells (SW-series) completed in the perched water-bearing zone. The network also consisted of nine PVC monitoring wells (MW-series) completed in the uppermost aquifer. A new ground-water monitoring network was installed that consists of six stainless steel monitoring wells (UA-series) and eighteen piezometers (B-series; installed between October 1987 and January 1988). The current monitoring well network is shown in Figure 1-3.

The refinery RCRA ground-water monitoring status has changed several times from assessment monitoring to detection monitoring and back, as a result of statistically significant changes (as defined by the required statistical data analyses) in the indicator parameters. In a letter dated June 5, 1984, Union Oil Company notified IEPA that the landfarm might be affecting ground-water quality. In June 1984, a ground-water assessment plan was prepared for the facility (T.M. Gates, 1984). This plan proposed a phased approach that utilized additional statistical analyses, followed by an expanded sampling program using existing monitoring wells, if necessary. An appropriate ground-water monitoring program has been followed since the landfarm opened. No hazardous waste constituents have been detected in the landfarm ground-water monitoring well network.

In September 1987, Union Oil Co. entered into a Consent Agreement and Final Order (CAFO, Docket No. V-W-87-R-015) that required the completion of a supplemental hydrogeologic investigation at the landfarm. Field work for the supplemental investigation was completed by ERT, Houston, Texas between October 1987 and February 1988. The investigation scope of work included the following items:

- installation of 18 PVC piezometers (between 96.5 and 132.6 feet deep) completed into bedrock;
- a location and vertical elevation survey of the new piezometers and existing monitoring wells (MW-1 through MW-9); and
- water level measurements from the piezometers and monitoring wells.

ERT summarized the field work and their findings in a report titled, "Summary Report of Supplemental Hydrogeologic Investigation for the UNOCAL Chicago Refinery Land Treatment Facility (ILD 041 550 567), Lemont, Illinois" (ERT, 1988).

1.4 PREVIOUS CLOSURE ACTIVITIES

In May 1988, Unocal submitted a three-phased Closure Plan/Post-Closure Operating Plan to IEPA that addressed closure of the landfarm. The objective of the closure plan was to provide a mechanism that would allow Unocal to continue to operate the landfarm while simultaneously implementing administrative closure procedures. In August 1988, the Closure Plan was approved by IEPA, subject to a number of conditions in the approval letter. Initial closure activities pursuant to the approved closure plan were completed by ERM. However, in October 1989, IEPA informed Unocal that a Part B Permit would be required even for application of non-hazardous waste at the landfarm. As a result of this determination by IEPA, it was decided not to complete the remaining closure tasks as described in the approved closure plan.

2.0 CLOSURE PERFORMANCE STANDARDS

In accordance with 35 IAC Section 725.211, this Closure Plan has been designed to meet the following general criteria:

- minimize the need for maintenance of the landfarm after closure activities are complete (35 IAC Section 725.211(a)); and

- control, minimize, or eliminate the migration, to the extent necessary to protect public health and the environment, of hazardous waste, hazardous waste constituents, leachate, contaminated runoff, and contaminated rainfall, run-off, or hazardous waste decomposition products to ground water, surface water, or the atmosphere (35 IAC Section 725.211(b)).

In addition, this Closure Plan addresses specific closure and post-closure criteria for land treatment units as required by 35 IAC Section 725.380.

3.0 SITE CHARACTERIZATION

3.1 WASTE CHARACTERIZATION

As discussed in Section 1.2, the waste types disposed at the landfarm were: clear well sludge; cooling tower sludge; heavy oil sludge; stormwater pond dredgings; water and wastewater sludge, and API Separator sludge. Annual disposal records (weight of waste applied and landfarm plot loadings) are summarized in Tables 3-1 and 3-2. API Separator sludge was the only hazardous waste disposed at the landfarm, and represented less than 1% of the total volume. The majority of the waste disposed at the landfarm was stormwater pond dredgings and water and wastewater sludge.

Tables 3-3, 3-4, and 3-5 summarize the chemical data for samples of the source material listed above. Based on laboratory data, the material contained 11 to 83% total solids; 3 to 64% volatile solids; trace to percent levels of oil and grease; and heavy metals, including cadmium, chromium, lead, nickel, and zinc.

3.2 TOPOGRAPHY AND HYDROLOGY

The landfarm is located in the southeast portion of the refinery (Figure 1-1), about ½-mile south and east of the bluff line bounding the Des Plaines River. The elevation of the landfarm is between 689 and 711 feet (ft) above mean sea level (msl), which is 89 to 111 ft above the elevation of most of the refinery property. In October 1988, the elevations of individual landfarm plots were surveyed by Beling Consultants, Joliet, Illinois under contract to ERM-North Central. The results of that survey were as follows:

Landfarm Plot	Minimum El. (ft)	Maximum El. (ft)
Area I	691	711
Area II	690	703
Area III	689	702
Area IV	694	709

A drainage ditch for surface water runoff flows through the landfarm, which collects runoff from the landfarm and the area to the east. Stormwater run-off from the landfarm currently flows through an adjacent property west of the landfarm, then returns to UNO-VEN property before being discharged to the UNO-VEN stormwater retention ponds and treated in the refinery wastewater treatment plant. The treatment plant discharges treated water to the Sanitary and Ship Canal under a National Pollutant Discharge Elimination System (NPDES) permit.

3.3 GEOLOGY

The soils at the landfarm consist of fine textured soils in the Ashkum, Blount, Chatsworth, or Morley series, suitable for agricultural production of corn, soybeans, small grains, grasses, and legumes. A detailed description of the soils is included in Section D-3b of the RCRA Part B Permit application.

The site geology consists of three geologic formations of contrasting lithologic and hydrogeologic properties (ERT, 1988). These formations are the Wadsworth Till, the Lemont Drift, and the Silurian Dolomite. The uppermost unit is the Wadsworth Till member which consists of yellow brown to brown to dark gray silty clay with a trace of pebbles. There are also discontinuous lenses of silty sand that are generally less than one foot thick. This clay unit ranges in thickness from approximately 18 ft to 61 ft and typically extends from the land surface downward to a subsurface elevation of about 660 $\pm$ 10 ft msl.

The Lemont Drift consists of two predominant lithologic types: 1) pebbly, soft to firm, clayey silt to sandy clayey silt till of direct glacial origin and 2) sand units of proglacial lacustrine and fluvial origin. Minor discontinuous layers of gravel, generally less than 2 ft thick occur sparsely within the Lemont Drift. The till units within the drift are gray to olive brown in color and contain pebbles that are angular, white to light gray dolomite clasts. The sand and silty sand units are predominantly olive brown to grayish brown and tend to be thicker and coarser grained in the lower portions of the drift. The Lemont Drift is generally 50 to 73 ft thick and overlies the Silurian bedrock.

The Silurian age bedrock consists of dolomite that is uniform in texture and rock quality and is typically yellow to light olive gray microcrystalline, moderately hard, with closely spaced fractures and occasional fossil structures replaced with cherty infilling material. It is relatively unweathered and there is little to no evidence of solution channels or interconnected solution vugs. The top of the dolomite occurs beneath the site at a subsurface elevation ranging from 606 to 596 ft in the southeast and northwest parts of the site, respectively. The depth to bedrock beneath the site ranges from about 95 to 122 ft below land surface (bls).

3.4 HYDROGEOLOGY

During a hydrogeologic investigation at the landfarm (ERT, 1988), the unsaturated zone at the site was found to extend from the land surface down through the Wadsworth Till member and the upper half to two-thirds of the Lemont Drift. Most of the silty sand lenses found in the Wadsworth Till were unsaturated, however, there were occasional perched water-bearing zones in the upper portion of the Lemont Drift.

The uppermost aquifer beneath the site consists of both the saturated, permeable strata (sandy silt, silty sand, sand, and gravel) occurring in the lower part of the Lemont Drift and the saturated, dolomite bedrock underlying the drift. These two saturated units are hydraulically interconnected and considered one hydrostratigraphic unit (ERT, 1988).

Based on field observations made during previous investigations, the hydraulic conductivity and transmissivity of the upper part of the Silurian dolomite is very low. A major portion of the transmissivity of the uppermost aquifer exists in the overlying, coarser grained strata constituting the basal part of the Lemont Drift. It is estimated that the hydraulic conductivity of this strata is 1×10^{-3} to 5×10^{-2} cm/sec.

The gradient of the Silurian dolomite potentiometric surface is essentially flat beneath the southern two-thirds of the landfarm. In May 1993, during ground-water monitoring performed pursuant to 35 IAC Subpart F, Geraghty & Miller, Inc. collected water level measurements from the existing monitoring well and piezometer network (Table 3-6). A potentiometric surface map was developed using these data (Figure 3-1). The direction of ground-water flow in the bedrock is to the northwest towards the Des Plaines River Valley, which is consistent with previous measurements. Using the potentiometric surface contours on Figure 3-1, the calculated hydraulic gradient is flat near the southern portion of the landfarm, and between about 0.002 and 0.0036 ft/ft over the northern portion of the landfarm.

During the preparation of the Part B Permit application (Attachment E-2), Unocal compiled an inventory of municipal and industrial wells near the refinery. Sixteen domestic and eighty-five municipal or industrial wells were found within a one-mile and five-mile radius of the refinery, respectively. Seventeen of the eighty-five municipal/industrial wells were test wells only. Selected water well logs were included in the Part B Permit application.

3.5 SITE MONITORING DATA DURING OPERATION

3.5.1 Unsaturated Zone (Lysimeter) Data

Seven lysimeters were installed in 1981 to monitor soil pore water beneath the active portions of the landfarm. In 1986, an additional lysimeter (L-8) was installed in the control area located in the northwest corner of the landfarm. Lysimeters L-1, L-3, L-4, and L-5 were destroyed in 1986 and L-6 was missing in June 1991. Therefore, samples could not be collected from these lysimeters at these times. In October 1987, Lysimeters L-2, L-3, L-4, and L-5 were replaced. The locations of the lysimeters are as follows:

Lysimeter	Location	Depth (Inches)
L-1	Area I	28
L-2	Area I	28
L-3	Area I	28
L-4	Area II	29
L-5	Area II	26
L-6	Area III	42
L-7	Area IV	38

Figure 3-2 shows the location of each lysimeter.

Between 1981 and 1991, soil water samples were analyzed annually or biannually for pH, oil and grease, zinc, lead, and total chromium. Select soil water samples were analyzed for vanadium between 1981 and 1985. In September 1981, samples from L-2, L-5, and L-7 were also analyzed for hexavalent chromium, arsenic, nickel, and copper. Samples could not be collected from each lysimeter during every sampling event because sufficient water did not always accumulate during the time period allowed.

Analytical results for soil water samples are summarized in Table 3-7. In Area I (L-1, L-2, and L-3), the pH of the soil water ranged from 6.8 to 7.6. Concentrations of zinc, lead, and total chromium ranged from 0.006 parts per million (ppm) to 1.14 ppm; <0.001 to 0.23 ppm; and 0.009 to 0.17 ppm, respectively. The oil and grease concentration in this area ranged from 0.8 to 13 ppm.

The pH in Area II (L-4 and L-5) ranged from 6.4 to 8.3. Concentrations of zinc, lead, and total chromium ranged from 0.007 to 0.45 ppm; <0.01 to 0.23 ppm; and 0.002 to 0.17 ppm, respectively. The oil and grease concentration ranged from 1.0 to 19 ppm.

In Areas III and IV, the pH ranged from 6.6 to 8.4. These areas contained concentrations of zinc, lead, and total chromium ranging from 0.007 to 0.22 ppm; 0.004 to 0.29 ppm; and 0.003 to 0.08 ppm; respectively. The concentration of oil and grease ranged from <0.01 to 5.9 ppm.

Samples from the lysimeter in the control area (L-8) had pH values ranging from 6.2 to 7.8 and oil and grease concentrations ranging from <0.1 to 1.6 ppm. The zinc, lead, and total chromium concentrations ranged from 0.05 to 0.25 ppm; <0.01 to 0.14 ppm; and <0.01 to 0.03 ppm, respectively.

In summary, the soil pore water samples indicate that the highest concentrations of zinc, lead, and total chromium are within Area I, which is the oldest landfarm plot. The range of metals concentrations in Areas II, III, and IV was not significantly above the control lysimeter range.

3.5.2 Phase I Closure Data

In October 1988, ERM performed Phase I closure activities in accordance with the Closure Plan (ERM, 1988) approved by IEPA (see Section 1.4). The objectives of the Phase I activities were to determine:

- potential migration pathways;
- maximum slope of each treatment plot;
- depth of sludge on each treatment plot (the treatment zone);
- surface contours of the landfarm;
- surface contours of the undisturbed soil; and,
- physical, chemical, and biological properties of each treatment plot.

The results of the Phase I field work are discussed below. Complete documentation of the work is contained in the Phase I Closure Report (ERM, 1989).

3.5.2.1 Treatment Zone Sampling

A sampling grid system was established for the landfarm using a 100-ft grid spacing. At each node, a split spoon sampler was driven until the interface between the treatment zone and undisturbed soil was reached, as determined by visual inspection. Soil sampling locations for laboratory analysis were selected using a random number generator. Twenty-two soil samples were collected (11 from Area I, 6 from Area II, 2 from Area III, and 3 from Area IV) using a split spoon sampler. Soil samples from the treatment zone and undisturbed soil were collected and analyzed for oil and grease, total and EP Toxicity metals, pH, cation exchange capacity, particle size distribution, moisture retention, electrical conductivity, buffering capacity, nutrients, and primary and secondary decomposers.

The results of the treatment zone interface sampling are summarized below:

		Depth to Treatment Zone Interface (inches)		
Area	# of Locations	Minimum	Maximum	Average
I	44	4	60	18
II	27	0	49	15
III	5	4	8	6
IV	14	9	32	17

Chemical data from the soil samples collected are summarized in Table 3-8. A review of the chemical data indicates that biological degradation of the waste materials has been taking place, as evidenced by a significant reduction in oil and grease. A buildup in the treatment zone of chromium and cadmium, and to a lesser extent, lead, has occurred over time. The concentrations of these constituents in the undisturbed zone, however, were within typical ranges for natural soils. The concentrations of cadmium, and lead in the undisturbed soil samples were at or below the background range when compared to samples collected for the Unocal Surface Impoundment Closure Plan (ERM, 1989). The concentration of chromium was slightly higher than the background range. The landfarm soil data and typical and site background ranges are shown in Table 3-9.

During the Phase I Closure activities, soil samples were also submitted for analysis of biological parameters (primary and secondary decomposers). The primary decomposers quantified were bacteria, actinomycetes, fungi, and invertebrate animals. The secondary decomposers quantified were invertebrate animals. Both active and inactive organisms were quantified from plate count procedures. No secondary invertebrates were detected in the soil samples. The biological sampling data generally supported the conclusion that degradation of the waste materials was occurring.

3.5.2.2 Stormwater Sampling

In May 1989, ERM-North Central collected stormwater runoff samples from each of the four landfarm plots. The purpose of the sampling was to evaluate the potential for affected runoff to migrate from the landfarm. One location on the topographically downgradient side of each plot was sampled. Water samples were collected after three separate storm events using a buried trough, which led to a subsurface collection bucket. Water samples were submitted for analysis of chemical oxygen demand (COD); fats, oil, and grease; pH; total suspended solids; total volatile solids; metals, volatile organic compounds (VOCs); and polynuclear aromatic compounds (PNAs).

No VOCs or PNAs were detected above detection limits from any of the nine stormwater samples. Metals were detected at or near detection limits during the first and second storm events, and below detection limits at Area III during the third storm event. Cadmium (0.034 mg/L), chromium (0.349 mg/L), and lead (0.55 mg/L) were detected in the sample collected from Area I during the third storm event. Table 3-10 summarizes the laboratory data from the stormwater sampling.

3.5.3 Ground-Water Monitoring

Unocal and UNO-VEN have performed ground-water monitoring at the landfarm since May 1981. The facility RCRA ground-water monitoring status has changed from detection to assessment monitoring and back over the years as a result of statistically significant changes in indicator parameters. However, hazardous constituents attributable to the landfarm have never been detected in the ground-water monitoring network. Ground-water detection monitoring is ongoing, following the requirements in 35 IAC Section 725.192 (Sampling and Analysis).

4.0 CLOSURE OPTIONS EVALUATION

Several closure options were considered, including: 1) clean closure (removal and off-site disposal of all waste materials in the landfarm: 2) closure in-place; and 3) a hybrid closure (limited removal of waste materials). Each option is described below.

4.1 CLEAN CLOSURE

Clean closure under RCRA requires that all hazardous waste be removed from the unit, followed by confirmation sampling that demonstrates compliance with appropriate cleanup standards. Assuming that the average thickness of waste over the four landfarm plots is 3 ft, and that the landfarmed area is 13.5 acres, the volume of waste at the landfarm is 65,300 cubic yards. Excavation, transportation, and disposal of this volume of material would merely transfer the waste to another disposal site. Assuming that the material is considered hazardous waste, the estimated cost for excavation, transportation, and disposal alone is $13 to $15 million. The benefits of clean closure include the reduction or elimination of maintenance and future monitoring, and the ability to use the site for other purposes. However, clean closure at the UNO-VEN Refinery landfarm is not necessary for the following reasons:

- significant migration of constituents of concern has not occurred based on soil sample and ground-water sample data collected since 1981; and

- the potential for future migration is low given the low permeability of soil beneath the landfarm treatment zone and the nature of the constituents of concern.

In summary, the benefits of clean closure relative to other options do not outweigh its considerable cost.

4.2 CLOSURE IN-PLACE

Closure in-place means that waste materials will be left on-site. Generally, a cover system is required to control surface water infiltration and reduce the potential for subsequent migration of constituents to ground water. Since a landfarm relies on the aerobic treatment of waste materials, the placement of an impermeable cap (clay cap) actually diminishes the effectiveness of treatment, and may cause the formation of toxic chemical byproducts or the mobilization of metals due to anaerobic conditions under the cap (USEPA, 1987). Ground-water monitoring has been conducted at the landfarm for over 10 years, and no significant degradation in ground-water quality has been detected.

A vegetative layer will help reduce the potential for erosion and chemical transport by wind and water. Infiltration of surface water will also be reduced, thus decreasing the potential for leaching constituents of concern into ground water. Therefore, for the UNO-VEN landfarm, it is recommended that only a vegetative layer be installed, with any required subbase material to provide for proper final contours. Continued ground-water monitoring under a post-closure permit will be required under this option.

4.3 HYBRID CLOSURE

A hybrid closure is typically considered when there are local areas within a site that contain significantly higher concentrations of hazardous waste or hazardous waste constituents. Based on the chemical data collected to date, there do not appear to be any areas at the landfarm that warrant selective removal.

4.4 PROPOSED CLOSURE OPTION

Since clean closure is inordinately expensive relative to its public health and environmental benefit, and no hot spots have been identified at the landfarm, closure in-place using a vegetative cover is the recommended option for closure of the UNO-VEN landfarm.

Prior to placement of the vegetative cover, it is proposed to till the four landfarm plots for two full seasons to allow further degradation of waste materials. Specific procedures for closure are described in Section 6.0.

5.0 ADDITIONAL STUDIES

5.1 TREATMENT DEMONSTRATION

5.1.1 Shallow Soil Sampling

Closure of the landfarm involves tilling for two seasons (each season: May to October) prior to placement of a vegetative cover. To demonstrate the effectiveness of tilling, baseline soil conditions will be established through the collection of soil samples from each landfarm plot and one background location. Composite soil samples will be collected from 1 ft bls and 2 ft bls and analyzed for oil and grease; total arsenic, cadmium, chromium, and lead; and biological screening parameters. At each landfarm plot, four locations will be composited into one sample from 1 ft bls and 2 ft bls. A total of 10 soil samples will be submitted for analysis (5 composites from 1 ft and 2 ft depths). Additional soil sample volume will be collected for potential analysis of arsenic, cadmium, chromium, and lead using the Toxicity Characteristic Leachate Procedure (TCLP). The decision to analyze TCLP samples will be made after receipt of the total metals data. The bioscreening evaluation will include the following:

- total aerobic heterotrophic plate counts;
- pH, ammonia-nitrogen, orthophosphate;
- percent moisture and percent moisture of holding capacity; and
- 24-hour respirometry (oxygen uptake, carbon dioxide production).

The bioscreening data will be collected to verify that the site contains an active population of organisms capable of degrading petroleum hydrocarbons.

Oil and grease data will be used as an indicator parameter to demonstrate that tilling of the waste materials is beneficial. Metals data will be used to show that these constituents are immobile or move very slowly in the subsurface environment.

5.1.2 Soil Profile Sampling

Soil samples will be collected from each landfarm plot to provide recent data on the treatment zone. Continuous split spoon samples will be collected at 1 ft intervals using a drill rig to a depth of 6 ft bls (just below the anticipated maximum depth of the treatment zone). At each landfarm plot, soil samples from four locations at the same depth will be composited in the field and submitted for analysis of oil and grease and total arsenic, cadmium, chromium, and lead. Additional soil volume will also be collected for potential TCLP analysis, as discussed above. A total of 28 soil samples will be submitted for analysis (7 from each landfarm plot).

5.1.3 Verification of Tilling Effectiveness

After establishing baseline conditions, tilling of the landfarm plots will begin. To verify the effectiveness of tilling, a laboratory study or field study will be conducted. Oil and grease will be used as the primary indicator of waste degradation. At this time, it is anticipated that four separate test samples or field study plots will be run: 1) an abiotic control (lab study only); 2) un-amended; 3) moisture controlled (lab study only); and 4) moisture and nutrient controlled. It is anticipated that tilling will occur at least three times per season. Specific procedures for the treatability demonstration, including a tilling schedule, will be developed after the baseline soil sampling task has been completed. At the completion of the pan or field studies, recommendations will be made regarding moisture control and nutrient addition to optimize waste degradation.

5.2 STORMWATER SAMPLING

During the collection of baseline soil samples from the landfarm, soil, sediment, and water samples will also be collected from the diversion ditches at the landfarm to assess the potential for off-site chemical migration from the landfarm. The diversion ditches will be constructed prior to the start of tilling. Samples will be submitted for analysis of oil and grease, polynuclear aromatic compounds (PNAs), and total metals. Four locations will be sampled within the landfarm area, three locations will be sampled downstream from the landfarm within about 500 ft of the west fence line, and one location will be sampled upstream from the landfarm to assess the nature of stormwater run-on.

6.0 CLOSURE ACTIVITIES

6.1 FINAL CLOSURE DESIGN

6.1.1 General

The UNO-VEN refinery landfarm Closure Plan is designed to minimize the need for further maintenance and reduce the potential for the escape of hazardous waste, hazardous constituents, leachate, contaminated run-off rainfall or hazardous waste decomposition products to the ground, surface water, or to atmosphere. The landfarm plots, which cover a total of approximately 13.5 acres, will be closed by the construction of a soil cover layer capable of sustaining vegetation and promoting surface water run-off and minimizing surface water infiltration.

6.1.2 Cover System Design

No portion of the completed cover system will have a finished grade of less than 4 percent, nor will the side slopes exceed a maximum of 33 percent. This final cover configuration will serve to promote the run-off of precipitation and the establishment of vegetation, while eliminating ponding and soil erosion. The following section provides a detailed description of the cover system.

6.1.2.1 Cover System Configuration

The cover system will consist of the following layers, constructed in ascending order:

- Subbase consisting of redistributed and graded existing waste material, and if required, common borrow material constructed to the appropriate subbase contours. The soil fill will consist of materials classified as SM-SC or ML-CL under the Unified Soil Classification System (USCS). The function of this layer is to provide a stable foundation upon which to construct the final cover system cap.

- Thirty inches of protective cover consisting of either 24 inches of common borrow soil fill and 6 inches of topsoil or 30 inches of soil fill if the soil contains sufficient organic material and nutrients to sustain plant growth. The soil fill will consist of materials classified as SM-SC or ML-CL under the USCS, with greater than 12 percent passing the No. 200 sieve. Topsoil will meet the Illinois Soil Conservation Service (SCS) standard specification.

- Seeding to establish vegetation, performed in accordance with the technical standards and specifications developed by the United States Department of Agriculture (USDA), Soil Conservation Service (SCS).

The proposed final cover system consists of 30 inches of soil. An analysis of the effectiveness of the cover system compared to existing conditions (no cover) was performed using the Hydrologic Evaluation of Landfill Performance (HELP) model developed by the U.S. Army Corp of Engineers. Evaluating existing conditions is considered the worst case scenario.

The addition of the proposed 30-inch final soil cover provided a 65.9 percent reduction in percolation of infiltrated surface water compared to the existing conditions. The HELP model results are presented in Appendix B.

6.1.2.2 Establishment of Vegetation

Seeding, mulching, and fertilizing will comply with the technical standards and specifications published by the USDA, SCS. Seeding will be performed by experienced and qualified personnel, utilizing equipment such as a fertilizer spreader and cyclone seeder, or a hydroseeder (slurry including fertilizer and seed), with a mulching machine utilized for the application of mulch capable of using a tackifer mixed with the mulch. Since oily wastes were applied at the landfarm, a series of test plots is recommended to determine the optimum seed types and mix.

The following materials and application specifications will be used:

- Seed will be labeled in accordance with the USDA Rules and Regulations under the Federal Seed Act, and furnished in sealed standard containers. All seed will be equal to or exceed the requirements of the technical standards and specifications.

- Starter fertilizer will be pelleted or granulated and have equal parts by percent weight of available nitrogen, phosphorus and potassium in order to supply a specified number of pounds of the pure chemicals per acre.

- Mulch will include straw from small grains, preferably wheat or rye.

Fertilizer, if required, will be applied within 24 hours prior to the tilling operation. The fertilizer will be distributed uniformly over the entire area to be seeded at the rate specified in the technical standards and specifications.

Seed or fertilizer will not be applied during periods of severe drought, high winds, excessive moisture, or on frozen ground. Seasonal seeding will be performed as necessary. The regular seeding season in the Chicago area is from March to May and from August to September. If seeding is required during the late fall, temporary seed mixes will be used, and the areas will be re-seeded with permanent seed mix the following spring.

6.1.2.3 Barrier Layer Integrity

The design of the cover system will consider the possibility for root advancement, differential waste settling, and frost to ensure the integrity of the barrier layer. The total design total thickness of the cover layer (30 inches) will prevent the penetration of roots and frost beyond the existing waste. The maximum depth of frost penetration at the site is 30 inches according to the USEPA document entitled, "Requirements for Hazardous Waste Landfill Design, Construction and Closure." Vegetation will be limited to shallow-rooted grasses with root systems significantly less than 30 inches deep. Tree seedlings and other potentially deciduous vegetation will be removed annualy.

Settlement of the waste beneath the load of the 30-inch thick cover will be assessed after final contours have been established. Waste consolidation occurs due to several factors, including type of waste; degree of compaction; waste decomposition; self-weight of the waste; removal of leachate; and construction of the final cover system. The most significant settlement factor at the UNO-VEN landfarm is the type of waste, which consists primarily of waste sludges. The inert nature of the waste will not result in volume reduction as a result of decomposition and the subsequent realignment of the remaining components. Most waste consolidation in the inert materials will occur before or during placement. In addition, any post-construction consolidation that occurs will generally be random across the entire landfarm area, manifested as small localized depressions.

6.1.3 Final Contour Plan

The final contours of each landfarm cell will be designed to promote the run-off of precipitation and the establishment of vegetation while eliminating ponding and soil erosion. The cover will also be designed to minimize required maintenance during post-closure care. The final contours will be designed with a maximum slope of 33 percent (3 horizontal to 1 vertical) and a minimum slope of 4 percent.

Grass-lined diversion ditches will control run-off of precipitation from the final cover, facilitating the removal of water, and thus minimizing infiltration. The design details of the surface water control systems are presented in Section 6.1.4.

6.1.4 Stormwater Management

6.1.4.1 General

Analysis and design of stormwater management and sedimentation and erosion control systems was performed using the SEDCAD+ Version 3.0 computer software program which is consistent with the methods prescribed by the USDA, SCS TR-55, entitled "Urban

Hydrology for Small Watersheds." The design storm for the grass-lined diversion channels and benches will be the 100-year, 24-hour recurrence interval rainfall event. All drainage structures will be designed after considering stormwater run-on, run-off, and erosion, as discussed in the following sections. Design calculations are presented in Appendices E and F.

6.1.4.2 Run-On Control

As depicted on the topographic map of the facility, potential surface water run-on will occur from the northeast and southwest, proceeding across the site in sheet flow to the existing drainage ditch which conveys surface water to the UNO-VEN stormwater retention ponds. The small volume of run-on will be rerouted around the landfarm cells by diversion channels aligned with the cell perimeter.

6.1.4.3 Run-Off Control

Run-off control measures will be necessary to maintain the pre-development or existing run-off flow rates. Stormwater run-off from the landfarm currently flows through an adjacent property west of the landfarm, then returns to UNO-VEN property before being collected in the UNO-VEN stormwater retention ponds. The design of the final contours will facilitate grading of the final cover system to tie into the existing topography. Run-off control measures will include run-off conveyance ditches coincident with the run-on diversion channels along the perimeter of the landfarm cells. This system of control measures will adequately control surface water run-off and potential erosion problems at the landfarm. The location of the channels is provided on Drawing Nos. 5 and 6.

6.1.4.4 Sedimentation and Erosion Control

The degree of erosion and sediment production will be calculated using the Universal Soil Loss Equation (Appendix C). Incorporating these results, all sediment control structures will be designed in accordance with SCS design criteria for the appropriate structure (Appendix C). Sedimentation and erosion control structures will be routinely and properly maintained, and will remain in service until after completion of construction and the site has been stabilized. Temporary erosion control devices, such as earthen berms, silt fences, and straw bales will be placed in appropriate locations during construction as necessary to direct or capture flow and minimize off-site transport of sediment. After stabilization, the temporary diversion channels and sediment control devices will be removed.

6.2 CONSTRUCTION INFORMATION

6.2.1 General

The UNO-VEN Refinery landfarm cover system has been designed to minimize surface water infiltration and promote surface water run-off and vegetative growth. The design of the cover system is presented in Section 6.1.2. This section discusses the procedures and timing for construction of the cover system and the Quality Assurance/Quality Control (QA/QC) Plan to be implemented during construction. Installation procedures will be discussed in general terms. Detailed construction specifications will be developed after the approval of the Closure Plan.

6.2.2 Site Preparation

6.2.2.1 General

Site preparation for construction of the cover system will include the establishment of survey control benchmarks; clearing and grubbing, if and where necessary; establishment of sediment/erosion control structures (e.g. silt fences, straw-bale dikes, and temporary diversion ditches); and site grading to establish preliminary subbase elevations.

6.2.2.2 Control Benchmarks

Three permanent benchmarks will be established at the landfarm for use in survey control throughout construction of the cover system. These benchmarks will be established from United States Geological Survey (USGS) Triangulation Stations present in the area to a minimum of third-order precision. The benchmarks will be located in areas of the site which will not be disturbed during construction activities. If any one of the benchmarks is damaged, a replacement benchmark will be established meeting the same criteria. All site activities will reference these benchmarks.

6.2.2.3 Clearing and Grubbing

The clearing of vegetation (e.g. grass, brush, trees, and the grubbing of roots and stumps) may be required prior to beginning construction of the cover system. Clearing will be required where necessary to provide an adequate and safe operating area and to efficiently operate construction equipment. These areas may include access roads, surface water control structures, and areas outside of the landfarm area to provide adequate room for final cover construction. Clearing will only be performed in areas necessary to complete the required construction activities to minimize additional disturbance to the site.

6.2.2.4 Sedimentation and Erosion Control Practices

Proper sedimentation and erosion control practices will be established prior to the start of tilling and maintained throughout the construction of the cover system. These control practices will protect against possible sedimentation and erosion problems which could result in off-site environmental degradation, or the potential failure of the environmental protection features of the cover system design.

Silt fences, straw-bale dikes and temporary diversion ditches or swales will generally be used for sedimentation and erosion control. Silt fences and straw bales are used to retard surface-water flow and to trap sediment. Temporary diversion ditches or swales are used to direct surface waters away from disturbed areas. These control structures limit the volume of sediment exiting the disturbed construction area as a result of surface water run-off across the disturbed areas.

6.2.2.5 Site Grading

Grading of the site will be performed to establish an adequate base for construction of the landfarm cover system. Existing waste in the landfarm areas will be redistributed and supplemented as necessary with fill material from outside borrow sources. The site grading and importing of outside fill material will be performed to establish a minimum top slope of 4 percent. All land surfaces will be graded to prevent ponding of water where waste has been graded and fill material has been placed.

6.2.3 Construction Quality Assurance/Quality Control

6.2.3.1 General

Overall QA/QC for construction of the cover system will be provided under the direction of an independent registered professional engineer licensed to practice engineering in the State of Illinois. Inspections will be made as deemed necessary, but at a minimum will occur weekly throughout the construction period. Final QA/QC approval will be provided by certification that the landfarm was closed in accordance with the approved Closure Plan and all applicable regulations.

Construction QA/QC for the cover system may be divided into two major categories: 1) materials to be incorporated into the cover system; and 2) procedures to be followed during construction of the cover system. Both topics are discussed in Sections 6.2.3.2 and 6.2.3.3, respectively.

6.2.3.2 QA/QC of Construction Materials

QA/QC for the materials to be incorporated into the cover system construction will be accomplished through field and laboratory testing. Field testing is discussed in the following section addressing QA/QC for construction inspection. Laboratory testing will involve performing tests required in the technical specifications and tests specified in the regulations. Where applicable, tests will follow American Society for Testing and Materials (ASTM) standards. Laboratory tests will determine, at a minimum, the following parameters for each component of the cover system construction:

- Soil Materials - off-site or borrow soils will be tested at a minimum for every 1,500 cubic yards of material. Tests to be performed will include moisture content, moisture-density relationship, Atterberg limits, particle-size distribution with both sieve and hydrometer methods, and permeability for samples reconstructed at 90 percent of the maximum modified proctor density. If borrow material is used to construct the protective cover (which will be vegetated), test for organic content and nutrients related to topsoil specifications will be performed, including pH and soluble salts.

- Granular materials - granular materials will be tested at a minimum for every 3,000 cubic yards of material. Tests to be performed will include particle-size distribution using sieve methods and permeability.

- Topsoil (if required) - material will be tested for moisture content, particle-size analysis using sieve and hydrometer methods, pH, soluble salts, organic content, and the presence of plants, plant parts, and noxious weeds.

In accordance with the technical specifications, the construction contractor will provide samples, certified test reports, and/or manufacturer's data to Unocal for acceptance and submission to the IEPA for documentation purposes. The transmittal of submissions will be accomplished in a timely manner to facilitate adequate reviews. Any variations in the technical specifications will be accompanied by a detailed explanation for a recommended substitution.

Upon arrival at the site, the contractor will verify compliance of construction materials with approved shop drawings and technical specifications. Any materials conflicting with the approved shop drawings and technical specifications will be rejected. Storage of construction materials will be in accordance with the manufacturer's recommendations, and as permitted by the construction contract documents.

6.2.3.3 QA/QC of Construction Procedures

Field testing will involve performing those tests required by the technical specifications, manufacturer's specifications, and tests specified in the regulations. Where applicable, the tests will be performed in accordance with ASTM standards. Field tests will include the following:

- Soil Materials - non-destructive tests (modified standard proctor) will be performed for moisture content and the compacted density specified in the construction specifications, at a rate of a minimum of 5 tests per acre per lift (6"-8" per lift).

Construction and installation inspection will be performed by an individual possessing adequate experience and knowledge of the construction of final cover systems. Field inspection will be performed to verify that the subbase and final cover system are constructed in accordance with the design specifications and all applicable regulations. Field inspection reports will be completed daily and made available for review at the site. The inspection of proper installation will include the following elements for each component of the cover system construction:

- Subbase - proper grading and achievement of specified moisture content, and performance of required tests, as required.

- Protective Cover - proper placement, performance of required tests, achievement of final rough grading and proper seeding, as specified; and,

- Topsoil (if required) - proper placement, performance of required tests, achievement of fine grading and proper seeding, as specified.

The results and certifications from the laboratory and field test programs will be available for review at the site.

6.2.4 Particulate Emissions Control and Construction Equipment Decontamination

If necessary during construction, particulate emissions will be controlled by maintaining proper moisture conditions, through the construction of wind screens, or application of a dust suppressant.

At the completion of closure activities, all construction equipment will be properly decontaminated prior to demobilization as required by 35 IAC Section 725.214. If any waste is generated that requires off-site disposal, proper testing and manifesting (if appropriate) will be performed. There are no structures at the landfarm that require decontamination.

6.2.5 Construction Certification

Upon completion of closure activities, a certification report will be prepared, which will include the following information:

- construction inspection reports;
- results of field testing;
- documentation of deviations from the permitted design;

- a notarized statement attesting to the truth and accuracy of the certification report to the best of the knowledge of Unocal; and,
- record drawings.

Record Drawings will include as-built drawings for major landfarm construction components and will indicate any deviations from the permitted design with explanations documented in a closure certification report. The closure certification report will be submitted to IEPA within 60 days after completion of final closure activities.

In conjunction with the preparation and submittal of the final closure certification report, Unocal will request a site inspection by the Director of IEPA, or an authorized representative. The purpose of this site inspection will be to allow the Director or an authorized representative to make a determination as to whether or not the cover system has been constructed in compliance with the regulations and this Closure Plan. In addition, the Director of the IEPA or his authorized representative, upon presentation of proper identification, may inspect the facility at any time during implementation of the Closure Plan to determine compliance with the Interim Status Regulations.

6.3 FINAL CLOSURE FINANCIAL ASSURANCE

6.3.1 Opinion of Probable Closure Cost

Closure of the landfarm will require capping the area of waste placement with a final cover system. An opinion of probable capital closure cost has been prepared using 1993 dollars (Table 6-1). Calculations for this opinion of probable cost are provided in Appendix D.

6.3.2 Financial Assurance Mechanism

Specific instruments of financial assurance will be by a closure trust fund, surety bond, letter of credit, closure insurance, or financial test and corporate guarantee, as described in 35 IAC Section 725.243 (Financial Assurance for Closure). This document will be provided to IEPA within 60 days after approval of this Closure Plan.

7.0 CLOSURE CERTIFICATION

7.1 CLOSURE CERTIFICATION STATEMENT

As required by 35 IAC Section 725.215, Unocal will submit a Certification of Closure to IEPA within 60 days after completion of closure of the landfarm. The Certification Statement will be signed by the owner/operator and an independent registered professional engineer licensed in the State of Illinois. The Certification Statement will follow the form contained in the IEPA Closure Plan preparation instructions (IEPA, 1990). A sample form is included in Appendix E. The Certification Statement will be submitted after the approved Closure Plan has been implemented.

As required by 35 IAC Section 725.216, a survey plat of the landfarm showing final contours will be submitted to the appropriate zoning authority(ies) and IEPA no later than the submission of the Certification of Closure.

7.2 MODIFICATION OF PART A APPLICATION

After completion of closure activities, a revised Part A Permit application will be submitted to IEPA.

8.0 CLOSURE SCHEDULE

Figure 8-1 shows the estimated schedule for closure based on the work described in this Closure Plan. This schedule will be revised as necessary after completion of the additional sampling and landfarm waste treatability demonstration.

9.0 POST-CLOSURE CARE PLAN

9.1 GROUND-WATER MONITORING

During post-closure, the existing UA-series monitoring wells will be sampled and analyzed consistent with current detection monitoring requirements at 35 IAC Subpart F. A report of the sampling activities will be submitted annually to IEPA and USEPA. A request for a shortened period of groundwater monitoring after closure may be submitted for approval (see Section 9.6).

9.2 SOIL CORE MONITORING

During the post-closure care period, soil core samples will be collected annually from each landfarm plot to verify that hazardous waste and hazardous waste constituents are not migrating below the treatment zone. One composite sample from four locations on each landfarm plot will be submitted for analysis of PNAs and total metals. A drill rig will be used to collect the samples from below this zone (about 6 ft bls), which will be identified using a split spoon sampler.

9.3 MIGRATION CONTROL

Control of waste migration to surface water during post-closure will be accomplished through proper cap maintenance, including the associated diversion structures. Migration to groundwater will be mitigated by reduced surface water infiltration, and monitored through the soil core monitoring program discussed above. Air emissions should be negligible or non-existent during the post-closure care period.

9.4 ROUTINE MAINTENANCE

Quarterly inspections of the landfarm will be conducted to ensure the integrity of the facility, including the following elements:

- Access roads;
- Run-on and run-off control measures;
- Fences and gates;
- Vegetation on the cap; and
- Signs.

Maintenance activities are expected to consist primarily of occasional site regrading and revegetation if erosion channels develop over time. If necessary, the monitoring well network will be rehabilitated or replaced during the post-closure care period.

9.5 SITE SECURITY

The entire landfarm area is surrounded by a fence with locked gates that is inspected and maintained by full-time UNO-VEN security personnel, which will continue during post-closure.

9.6 COST ESTIMATE

Table 9-1 provides a preliminary estimate of annual post-closure care costs and a present worth cost assuming a 5% interest rate and 30-year closure period. However, a shorter post-closure care period may be requested as allowed by 35 IAC Section 725.217 (a)(2)(A). If requested, this determination will be based on site-specific data (e.g. waste characteristics, cap integrity, groundwater monitoring well results, stormwater runoff data). The threshold criterion for a shortened post-closure care period is protection of public health and the environment.

10.0 REFERENCES

ERM-North Central, Inc. 1988. Closure Plan/Post Closure Operating Plan for Land Treatment Area at Unocal Corporation Chicago Refinery, Lemont, Illinois. May 1988.

ERM-North Central, Inc. 1989. Phase I Closure Report for Land Treatment Area, Unocal Corporation Chicago Refinery, Lemont, Illinois. June 16, 1989.

ERM-North Central, Inc. and T.M. Gates, Inc. 1984. RCRA Part B Permit Application. July 1984.

ERT. 1988. Summary Report of Supplemental Hydrogeologic Investigation for the UNOCAL Chicago Refinery Land Treatment Facility (ILD 041 550 567) Lemont, Illinois. May 1988.

Illinois Environmental Protection Agency. 1990. Instructions for the Preparation of Closure Plans for Interim Status RCRA Hazardous Waste Facilities. December 11, 1990.

USEPA. 1987. Part 265 Land Treatment Closure/Post Closure Guidance. Office of Solid Waste and Emergency Response Directive Number 9476.00-9. April 14, 1987.

USEPA. 1989. Requirements for Hazardous Waste Landfill Design, Construction and Closure, August 1989. EPA/625/8-89/022.

Table 3-1. Annual Weight of Waste Applied at the Landfarm, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

Waste Type	1981	1982	1983	1984	1985	1986	1987
Water and Wastewater Sludge	1800	1444	2060	1361	549	0	1004
Storm Water Pond Dredgings	0	2328	1650	0	2258	0	0
Clear Well Sludge	0	200	0	0	0	0	0
Tank Cleaning Waste	150	0	0	0	0	0	0
Cooling Tower Sludge	0	0	25	0	0	0	0
API Separator Sludge [1]	18	0	0	0	0	0	0
Heavy Oil Sludge	0	10	0	0	0	0	0
Total	1968	3982	3735	1361	2807	0	1004

All data in dry tons.
Records unavailable prior to 1981.
[1] Estimated to be 1% of water and wastewater sludge.

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Table 3-2. Annual Landfarm Plot Loadings, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

Waste Plot	1981	1982	1983	1984	1985	1986	1987
Area I	305	264	305	147	279	0	90
Area II	60	318	60	98	261	0	114
Area III + Area IV	317	318	317	36	270	0	0
Total	682	900	682	281	810	0	204

All data in dry tons per acre.
Records unavailable prior to 1981 (only Plot I open prior to 1981).
Source: Phase I Closure Report, ERM-North Central, Inc. (May 1988).

JT\CI26402\PLOTLOAD.WK1

Table 3-3. Summary of Waste Sludge Chemical Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

Parameter	*Clear Well Sludge* (ppm)	*Clear Well Sludge* EP Tox (mg/L)	*Cooling Tower Sludge* (ppm)	*Cooling Tower Sludge* EP Tox (mg/L)	*Heavy Oil Sludge* (ppm)	*Heavy Oil Sludge* EP Tox (mg/L)
Total Solids	110000		670000		460000	
Volatile Solids	30000		240000		130000	
Oil and Grease	19		313		520000	
Total Cyanide	7		15		ND	
Total Sulfide	700		11700		ND	
Total Phenol	1.3		2.1		25	
Arsenic	1.7	ND	43	0.02	ND	ND
Barium	80	0.4	200	0.4	270	0.3
Cadmium	0.9	0.01	ND	0.02	6	ND
Calcium	4200		5400			
Chromium, Total	260	0.03	36000	0.05	3	ND
Copper	20	0.04	400	0.01	3	ND
Iron	4800		5500			
Lead	31	0.02	130	ND	21	ND
Magnesium	2400		3200			
Mercury	ND	ND	ND	ND	ND	ND
Nickel	11	0.04	100	0.04	8	ND
Selenium	0.1	ND	38	ND	ND	ND
Silver	2.1	ND	8	ND	ND	ND
Vanadium	36		400		19	
Zinc	99	0.07	30000	2.4	1	0.1

ND - not detected.
Dates of sampling - Clear Well: 1982; Cooling Tower: 4/15/83; Heavy Oil: 7/6/82.
Source: Phase I Closure Plan, ERM-North Central, Inc. (May 1988).

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Table 3-4. Summary of Storm Water Pond Dredgings Chemical Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

	East Pit		*West Pit*			6/3/81		
Parameter	11/6/82 (ppm)	EP Tox (mg/L)	11/6/82 (ppm)	EP Tox (mg/L)	7/8/82 (ppm)	EP Tox (mg/L)	4/28/81 (ppm)	9/8/80 (ppm)
Total Solids	829000		564000		400000		407000	
Volatile Solids	136000		64000					
pH	7.1		6.9		8.3			9.1
COD	213000		121000					
Oil and Grease	112000		132000		43000		25000	
Total Cyanide	7		5				10.5	
Total Sulfide	ND		3200		1100		1400	<10
Total Phenol	2.7		2				6.4	
Total Phosphorus	1300		200					
Sodium	3200		4000					
Ammonia	490		300					
Nitrogen	2030		1650					
Aluminum	33100		21200					
Arsenic	15	ND	170	0.03		0.055	3	7.5
Barium	400	0.9	210	0.9		1	76	
Cadmium	ND	ND	17	0.08		ND	3	2.2
Calcium							135000	
Chromium, Total	1800	0.2	250	ND	625		1600	1310
Chromium, Hexavalent	151		65			ND		
Chromium, Trivalent						0.25		
Copper	85		900			0.05	39	45.2
Cobalt	33		29					
Iron	32000		30000				10700	
Lead	130	ND	1300	1	19	0.29	37	48
Magnesium							13200	
Mercury	ND	ND	ND	ND		ND	ND	
Nickel	44		51			0.4	58	66.4
Selenium	ND	ND	ND	ND		ND	3	
Silver		ND		ND		ND	ND	
Vanadium	170		111		72		64	
Zinc	990		1000		450	0.23	1500	1090
Acidity (mg CaCO3/g)	ND		ND					
Alkalinity (mg CaCO3/g	75		37					

ND - not detected.

Source: ERM-North-Central, Inc. (May 1988).

JT\CI26402\STRMPOND.WK1

Table 3-5. Summary of Water and Wastewater Sludge Chemical Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

Parameter	10/26/82 (ppm)	10/26/82 EP Tox (mg/L)	7/8/82 (ppm)	4/28/82 (ppm)	6/3/81 EP Tox (mg/L)	9/8/80 (ppm)
Total Solids	455000		160000	471000		506800
Volatile Solids	26000					
pH	9.3		8.6			9
COD	33000					
Oil and Grease	895		860	8800		
Total Cyanide	4					
Total Sulfide	200		100	200		<10
Total Phenol	1.9			3.9		
Total Phosphorus	100					
Sodium	1100					
Ammonia	270					
Nitrogen	910					
Aluminum	1900					
Arsenic	5	0.01		ND	0.105	3.9
Barium	51	0.5		70	0.2	
Cadmium	ND	ND		ND	0.01	1.8
Calcium				155000		63.5
Chromium, Total	250	0.03	155	282		
Chromium, Hexavalent	200	ND				
Copper	57			ND	0.04	11.9
Cobalt	3					
Iron	2600			9300		
Lead	11	0.1	5	20	0.23	34.4
Magnesium				12800		
Mercury	ND	ND		ND	ND	
Nickel	20			29	0.6	22.6
Selenium	ND	ND		ND	ND	
Silver		ND		ND	ND	
Vanadium	49		18	25		
Zinc	147		81	165	0.12	119
Acidity (mg CaCO3/g)	ND					
Alkalinity (mg CaCO3/g)	345					

ND - not detected.
Source: Phase I Closure Report, ERM-North Central, Inc. (May 1988).

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Table 3-6. Summary of Water Level Measurement Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

Monitoring Well/ Piezometer	Date Measured	TOC Elevation (ft MSL)	Depth to Water From Top of Casing (ft)	Depth to Bottom of Well (ft)	Bottom of Well Elevation (ft MSL)	Ground-Water Surface Elevation (ft MSL)
Monitoring Well Water Level Measurement Data (UA-Series)						
UA-1	5/19/93	718.80	93.80	107.80	611.00	625.00
UA-2	5/18/93	692.24	67.30	85.50	606.74	624.94
UA-3	5/18/93	697.73	72.95	89.50	608.23	624.78
UA-4	5/18/93	695.98	71.75	87.20	608.78	624.23
UA-5	5/18/93	694.84	72.15	92.30	602.54	622.69
UA-6	5/18/93	701.76	77.65	94.80	606.96	624.11
Piezometer Water Level Measurement Data (B-Series)						
B-1	5/18/93	695.20	72.25	110.80	584.40	622.95
B-2	5/18/93	697.06	72.20	109.70	587.36	624.86
B-3	5/18/93	712.07	87.44	125.30	586.77	624.63
B-4	5/18/93	683.34	60.33	98.70	584.64	623.01
B-5	5/18/93	688.49	63.59	103.20	585.29	624.90
B-6	5/18/93	700.46	75.42	112.50	587.96	625.04
B-7	5/18/93	705.12	80.20	116.30	588.82	624.92
B-8	5/18/93	707.45	82.90	117.50	589.95	624.55
B-9	5/18/93	693.17	68.14	107.80	585.37	625.03
B-10	5/18/93	713.46	88.43	126.00	587.46	625.03
B-11	5/18/93	721.09	95.91	130.50*	590.59	625.18
B-12	5/18/93	723.29	98.10	135.50	587.79	625.19
B-13	5/18/93	718.26	93.17	123.70	594.56	625.09
B-14	5/18/93	686.08	63.10	99.00	587.08	622.98
B-15	5/18/93	721.54	97.68	136.90	584.64	623.86
B-16	5/18/93	719.63	94.52	124.80*	594.83	625.11
B-17	5/18/93	727.02	101.60	127.30	599.72	625.42
B-18	5/18/93	709.14	84.08	123.54	585.60	625.06

NOTES:

ft MSL = feet Mean Sea Level.
ft = feet.
* = *Data obtained from ENSR sampling report dated July 7, 1992.*

Table 3-7. Summary of Lysimeter Analytical Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

				Lysimeter L-1			
Sampling Date	Appearance	pH	Oil and Grease	Zinc	Lead	Total Chromium	Vanadium
11-08-83	--	6.9	--	--	--	--	--
06-04-84	clear, yellow	--	--	--	--	--	--
06-21-85	clear, yellow	7.16	0.8	0.13	<0.1	0.04	<0.1
11-14-85*	clear, yellow	6.9	11	0.26	0.1	0.08	--
12-16-85*	--	--	--	--	--	--	<0.1
05-16-86	clear, yellow	7.6	--	0.25	0.10	0.03	--

				Lysimeter L-2		
Sampling Date	Appearance	pH	Oil and Grease	Zinc	Lead	Total Chromium
09-10-81	--	7.4	--	0.006	<.001	0.009
11-08-83	--	6.9	13	0.19	0.13	0.05
06-04-84	clear, yellow	--	--	--	--	--
06-21-85	clear, yellow	--	--	--	--	--
05-16-86	clear, yellow	7.6	5.1	0.22	0.15	0.03
11-10-86	clear, yellow-orange	7.2	3.4	1.14	0.21	0.03
05-28-87	clear, yellow-orange	6.9	3.7	1.03	0.10	0.07
11-17-87	yellow, sediment	7.2	2.0	0.65	0.10	0.08
05-17-88	yellow, sediment	7.9	--	0.57	0.23	0.0
12-14-88	clear, yellow	7.1	--	0.29	0.01	0.02
05-12-89	cloudy, yellow	7.2	--	0.355	<0.05	0.17

All concentrations are expressed in parts per million (ppm).
-- - constituent not reported for that sample.
* - sampling date is unavailable. The reported date is given.

Table 3-7. Summary of Lysimeter Analytical Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

	Lysimeter L-2				
Sampling Date	Hex Chromium	Vanadium	Arsenic	Nickel	Copper
09-10-81	<0.002	0.523	0.045	0.029	0.027
11-08-83	--	0.15	--	--	--
06-04-84	--	--	--	--	--
06-21-85	--	--	--	--	--
05-16-86	--	--	--	--	--
11-10-86	--	--	--	--	--
05-28-87	--	--	--	--	--
11-17-87	--	--	--	--	--
05-17-88	--	--	--	--	--
12-14-88	--	--	--	--	--
05-12-89	--	--	--	--	--

				Lysimeter L-3			
Sampling Date	Appearance	pH	Oil and Grease	Zinc	Lead	Total Chromium	Vanadium
11-08-83	--	6.7	--	--	--	--	--
06-04-84	clear, yellow	6.8	10.4	0.14	<0.1	0.01	0.05
05-17-88	clear, yellow	7.0	5.1	1.09	0.23	0.02	--
12-14-88	cloudy, yellow	7.1	5.8	0.11	0.01	0.01	--
05-12-89	cloudy, yellow	7.3	8.4	0.219	<0.05	<0.13	--
07-19-90	slight yellow	6.8	6.4	0.321	<0.01	0.08	--
06-24-91	hazy, amber	7.2	2.3	0.6	<0.01	0.11	--

All concentrations are expressed in parts per million (ppm).

-- - constituent not reported for that sample.

Table 3-7. Summary of Lysimeter Analytical Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

			Lysimeter L-4				
Sampling Date	Appearance	pH	Oil and Grease	Zinc	Lead	Total Chromium	Vanadium
11-08-83	--	6.4	4.6	0.01	0.01	0.01	0.03
06-04-84	cloudy, orange-yellow	--	--	--	--	--	--
06-21-85	cloudy, orange-yellow	6.4	19	0.23	<0.1	0.02	<0.1
11-17-87	cloudy, gray	7.0	1.3	0.04	<0.10	0.03	--
05-17-88	cloudy, orange-brown	8.3	--	0.19	0.15	0.08	--
05-12-89	cloudy, yellow	7.3	8.4	0.219	<0.05	<0.13	--

			Lysimeter L-5			
Sampling Date	Appearance	pH	Oil and Grease	Zinc	Lead	Total Chromium
09-10-81	--	7.2	--	0.007	0.010	0.002
11-08-83	--	7.0	--	--	--	--
06-04-84	clear, yellow	6.9	4.2	0.11	<0.1	0.01
11-14-85*	clear, yellow	7.0	11	0.16	<0.1	0.01
12-16-85*	--	--	--	--	--	--
05-16-86	clear, yellow	7.6	2.9	0.16	0.08	0.02
11-17-87	yellow	7.1	1.2	0.12	<0.10	0.01
05-17-88	light yellow, cloudy	6.8	8.8	0.45	0.23	0.02
12-14-88	cloudy, yellow	6.8	5.4	0.04	0.01	0.02
05-12-89	hazy, yellow	6.7	1.0	0.13	<0.05	0.17
07-19-90	cloudy, yellow	7.1	2.1	0.13	<0.01	0.10
06-24-91	hazy, amber	7.1	1.3	0.23	<0.01	0.02

All concentrations are expressed in parts per million (ppm).
-- - constituent not reported for that sample.
* - Sampling date is unavailable. The reported date is given.

Table 3-7. Summary of Lysimeter Analytical Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

	Lysimeter L-5				
Sampling Date	Hex Chromium	Vanadium	Arsenic	Nickel	Copper
09-10-81	<0.002	0.081	0.031	0.011	0.007
11-08-83	--	--	--	--	--
06-04-84	--	0.03	--	--	--
11-14-85*	--	--	--	--	--
12-16-85*	--	<0.1	--	--	--
05-16-86	--	--	--	--	--
11-17-87	--	--	--	--	--
05-17-88	--	--	--	--	--
12-14-88	--	--	--	--	--
05-12-89	--	--	--	--	--
07-19-90	--	--	--	--	--
06-24-91	--	--	--	--	--

				Lysimeter L-6			
Sampling Date	Appearance	pH	Oil and Grease	Zinc	Lead	Total Chromium	Vanadium
12-15-82	--	7.2	0.5	0.01	<0.01	0.01	0.094
11-08-83	--	6.6	--	--	--	--	--
06-04-84	clear, yellow	--	--	--	--	--	--
05-16-86	clear, yellow	7.2	5.1	0.15	0.10	0.04	--
11-10-86	clear, yellow	6.9	5.9	0.04	0.29	0.04	--
05-28-87	clear, yellow	6.9	3.1	0.14	0.09	0.02	--
12-14-88	clear, yellow	6.9	2.8	0.04	0.10	0.01	--
05-12-89	clear, yellow	7.3	1.1	0.11	<0.05	0.08	--

All concentrations are expressed in parts per million (ppm).

-- - constituent not reported for that sample.

* - Sampling date is unavailable. The reported date is given.

Table 3-7. Summary of Lysimeter Analytical Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

				Lysimeter L-7		
Sampling Date	Appearance	pH	Oil and Grease	Zinc	Lead	Total Chromium
09-10-81	--	6.8	--	0.007	0.004	0.003
5-82	--	--	--	0.04	<0.01	0.01
12-15-82	--	7.0	2.7	0.06	<0.01	<0.01
11-08-83	--	6.8	2.3	0.02	0.03	<0.01
06-04-84	clear, yellow	6.9	3.2	<0.01	<0.1	<0.01
06-21-85	clear	7.1	<0.1	0.02	<0.1	0.01
11-14-85*	clear, light yellow	7.2	7	0.07	<0.1	0.01
12-16-85*	--	--	--	--	.	.
11-10-86	clear, colorless	7.3	--	0.18	0.21	<0.01
11-19-87	clear, light yellow	6.7	0.7	0.12	<0.10	0.01
05-17-88	clear, light yellow	8.4	--	0.22	0.23	<0.01
12-14-88	clear	7.2	--	0.10	0.01	<0.01
07-25-90	clear	7.0	0.2	0.078	<0.01	0.02

All concentrations are expressed in parts per million (ppm).
-- - constituent not reported for that sample.
* - Sampling date is unavailable. The reported date is given.

Table 3–7. Summary of Lysimeter Analytical Data, Closure Plan for the Land Treatment Area, UNO–VEN Refinery, Lemont, Illinois.

	Lysimeter L–7				
Sampling Date	Hex Chromium	Vanadium	Arsenic	Nickel	Copper
09–10–81	<0.002	0.244	0.030	0.010	0.009
5–82	--	.	--	--	--
12–15–82	--	0.061	--	--	--
11–08–83	--	0.02	--	--	--
06–04–84	--	<0.01	--	--	--
06–21–85	--	<0.1	--	--	--
11–14–85*	--	--	--	--	--
12–16–85*	--	0.1	--	--	--
11–10–86	--	--	--	--	--
11–19–87	--	--	--	--	--
05–17–88	--	--	--	--	--
12–14–88	--	--	--	--	--
07–25–90	--	--	--	--	--

			Lysimeter L–8			
Sampling Date	Appearance	pH	Oil and Grease	Zinc	Lead	Total Chromium
05–16–86	clear	6.2	<0.1	0.21	0.03	0.01
11–10–86	clear, colorless	7.1	0.7	0.24	0.14	0.01
06–09–87	clear, colorless	6.7	0.4	0.25	0.02	0.03
11–17–87	clear	6.9	1.3	0.20	0.10	<0.01
05–17–88	clear	7.0	1.6	0.09	0.08	<0.01
12–14–88	clear	7.3	1.0	0.05	0.13	0.01
05–12–89	clear	7.8	<0.1	0.13	<0.05	0.02
07–19–90	clear	7.6	0.1	0.204	<0.01	0.03

All concentrations are expressed in parts per million (ppm).

* – Sampling date is unavailable. The reported date is given.

Table 3–8. Summary of Phase I Closure Data, Closure Plan for the Land Treatment Area, UNO–VEN Refinery, Lemont, Illinois.

Parameter	*Area I* Treat.	*Area I* Undist.	*Area II* Treat.	*Area II* Undist.	*Area III* Treat.	*Area III* Undist.	*Area IV* Treat.	*Area IV* Undist.
Inorganics (ppm)								
Arsenic	8	8.2	5.7	9.5	10.2	8.3	7.7	11.2
Cadmium	1.51	0.12	1.87	0.06	2.83	0.06	5.16	0.12
Chromium	948	31	425	15	191	16	617	15
Lead	85	16	264	6.5	278	10	329	13
Calcium	4344	3291	4494	3714	4358	3295	4774	4084
Magnesium	1313	970	1513	878	792	568	732	949
Sulfur	35	36	42	40	45	38.8	45	45
Iron	67	36	89	32	36	30	106	46
Manganese	32.2	36.1	34.4	56	12	12.2	38.6	55.1
Copper	5.2	1.7	8	2	15	1.3	9.9	9.2
Zinc	8.7	4.8	8.7	2.6	8.7	1.9	8.8	6.5
EP Toxicity (mg/L)								
Arsenic	0.002	0.001	0.003	0.001	0.002	0.001	0.002	0.001
Cadmium	0.02	0.02	0.024	0.02	0.041	0.02	0.045	0.02
Chromium	0.08	0.02	0.08	0.02	0.06	0.03	0.1	0.02
Lead	0.1	0.1	0.15	0.1	0.41	0.1	0.13	0.1
Nitrogen (% TTLKj)	0.365	0.092	0.318	0.113	0.22	0.075	0.348	0.087
Phosphorus (lbs/acre)	23	12	21	15	18	12	21	19
Potassium (lbs/acre)	128	174	143	177	290	163	136	207
Oil and Grease (%)	2.21	0.009	1.19	0.005	0.11	0.005	1.64	0.007
Cation Exchage Capacity	11.57	14.19	11.22	15.26	13.78	10	15.11	22.59
pH	7.6	7.6	7.8	7.8	8	7.3	7.6	7.3
Elect. Cond. (mmhos/cm)	2.4	0.96	2.5	0.77	0.48	0.45	1.7	0.83

Values shown are averages from samples collected in each area.
Treat. - Treatment zone soil sample.
Undist. - Undisturbed soil sample.
Source: Phase I Closure Report, Tables 43 and 44 (ERM-North Central, Inc., June 1989).

JT\CI26402\PHI_DATA.WK1

Table 3-9. Comparison of Landfarm Soil Sample Data to Background Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

Parameter	Treatment Zone	Undisturbed Soil	Typical Range [1]	Background Range [2]
Inorganics (ppm)				
Arsenic	7.9	9.3	1-50	14-17
Calcium	4492	3596	7000-500000	
Cadmium	2.84	0.09	0.01-0.7	1.0-1.7
Chromium	545	19	1-1000	13-17
Copper	9.5	3.6	2-100	
Iron	75	36	7000-550000	
Potassium	174	180	400-550000	
Magnesium	1088	841	600-30000	
Manganese	29.3	40		
Nitrogen	3130	920	200-6000	
Potassium	21	14.5	650	
Lead	239	11	2-200	24-39
Sulfur	42	40	30-900	
pH	7.8	7.5		4.6-7.35
Cation Exch. Cap.	12.9	15.5		18-25
N/P	150	65		

[1] Chemical Equilibria in Soil, W.L. Lindsay, 1979.
[2] Unocal Surface Impoundment Closure Plan, 1986.
Treatment zone soil and undisturbed soil data are averages from 4 landfarm plots.
Source: Phase I Closure Report, Table 45, ERM-North Central, Inc., June 16, 1989.

JT\CI26402\BG_DATA.WK1

Table 3-10. Summary of Storm Water Sampling Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

Storm Event #1

Parameter	Area I	Area II	Area III	Area IV
Chemical Oxygen Demand	76	118	72	72
Fats, Oil, and Grease	4	3	3	4
pH	7.72	7.1	7.58	7.29
Total Suspended Solids	2350	2780	3690	2060
Total Volatile Solids	680	490	385	345
Arsenic	<0.001	0.001	<0.001	<0.001
Cadmium	<0.001	<0.001	<0.001	<0.001
Chromium	<0.001	<0.001	<0.001	<0.001
Lead	<0.01	<0.01	<0.01	<0.01
Polynuclear Aromatic Compounds	BDL	BDL	BDL	BDL

Storm Event #2

Parameter	Area I	Area II	Area III	Area IV
Chemical Oxygen Demand	66		52	114
Fats, Oil, and Grease	5		2	8
pH	7.62		7	7.6
Total Suspended Solids	4690		300	6120
Total Volatile Solids	705		40	745
Arsenic	<0.001		<0.001	<0.001
Cadmium	<0.001		<0.001	0.004
Chromium	<0.001		<0.001	<0.001
Lead	<0.01		<0.01	<0.01
Volatile Organic Compounds	BDL		BDL	BDL
Polynuclear Aromatic Compounds	BDL		BDL	BDL

Table 3-10. Summary of Storm Water Sampling Data, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

Storm Event #3

Parameter	Area I	Area II	Area III	Area IV
Chemical Oxygen Demand	2070		86	
Fats, Oil, and Grease	54		2	
pH	5.58		7.07	
Total Suspended Solids	3550		756	
Total Volatile Solids	4050		80	
Arsenic	<0.01		<0.001	
Cadmium	0.034		<0.001	
Chromium	0.349		<0.001	
Lead	0.55		<0.01	
Volatile Organic Compounds	BDL		BDL	

All data in mg/L except pH.
BDL - Below detection limit.
Samples collected May 1989.
Source: Phase I Closure Report, ERM-North Central, June 1989.

JT\C126402\STRMDATA.WK1

Table 6-1. Preliminary Closure Cost Estimate, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

Item	Quantity	Unit Cost	Total Cost
Sampling and Monitoring		ls est	$30,000
Erosion Controls		ls est	$20,000
Tilling		ls est	$70,000
Mobilization and Demobilization	1	$50,000	$50,000
Clearing and Grubbing	2 AC	$725/AC	$1,500
Site Grading	21,780 CY	$1.33/CY	$29,000
Common Borrow	81675 CY	$12.07/CY	$985,800
Seed & Mulch	65,340 SY	$0.30/SY	$19,600
Subtotal			$1,206,000
Engineering and Permitting			$181,000
Construction Management			$100,000
Construction QA/QC			$25,000
Total			$1,512,000
Contingencies (20%)			$302,000
TOTAL COST			$1,814,000

JT\CI26402\COST_EST.WK1

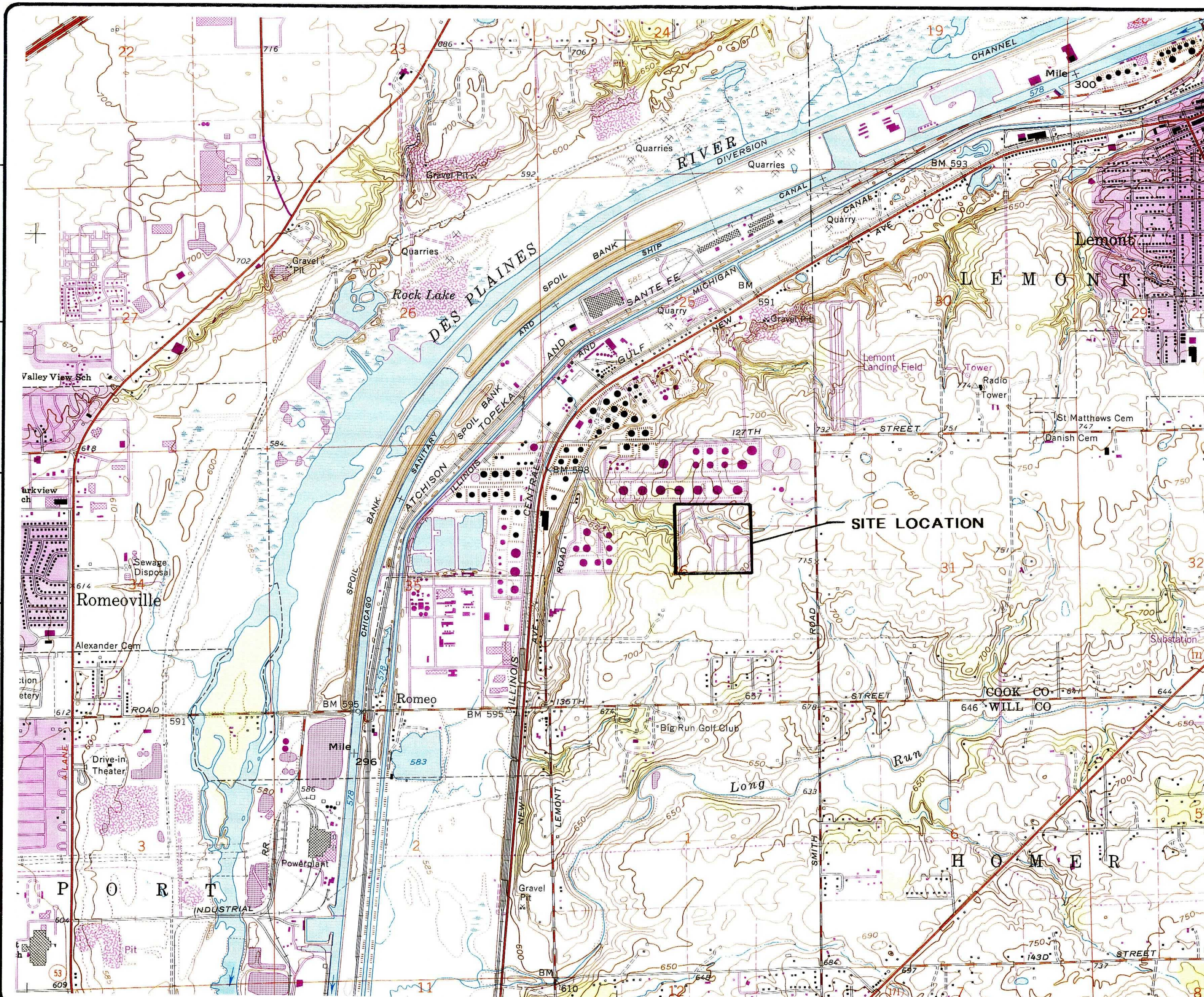
Table 9-1. Cost Estimate for Post-Closure Care, Closure Plan for the Land Treatment Area, UNO-VEN Refinery, Lemont, Illinois.

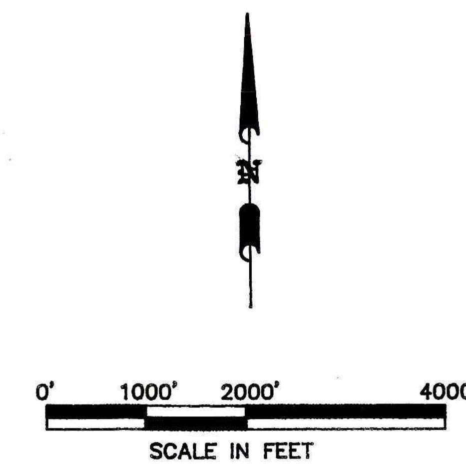
Cost Element	Unit Cost	Unit	Units Req'd	Total
Groundwater Sampling [1]	$15,000	yr	1	$15,000
Soil Core Sampling [1]	$10,000	yr	1	$10,000
Inspections	$5,000	yr	1	$5,000
Routine Maintenance	$20,000	yr	1	$20,000
Total Annual Cost				$50,000
Present Worth of Annual O&M (5%, 30 yrs)				$769,000

[1] Average estimated annual cost over life of project.

JT\CI26402\POSTCLOS.WK1

DWG DATE: 9/13/93 | PRJCT NO.: CI0264.002 | FILE NO.: NON-CAD | DRAWING: CI26402-B1-1 | CHECKED: J TANAKA | APPROVED: J TANAKA | DRAFTER: S GOZNER 1=1





SOURCE:
USGS 7.5 MIN. TOPOGRAPHIC MAP,
ROMEOVILLE, ILLINOIS QUADRANGLE,
1962, PHOTOREVISED 1973 AND 1980.

QUADRANGLE LOCATION

SITE LOCATION MAP
CLOSURE PLAN FOR THE LAND TREATMENT AREA
UNO-VEN REFINERY
LEMONT, ILLINOIS

FIGURE
1-1

GERAGHTY & MILLER, INC.
Environmental Services

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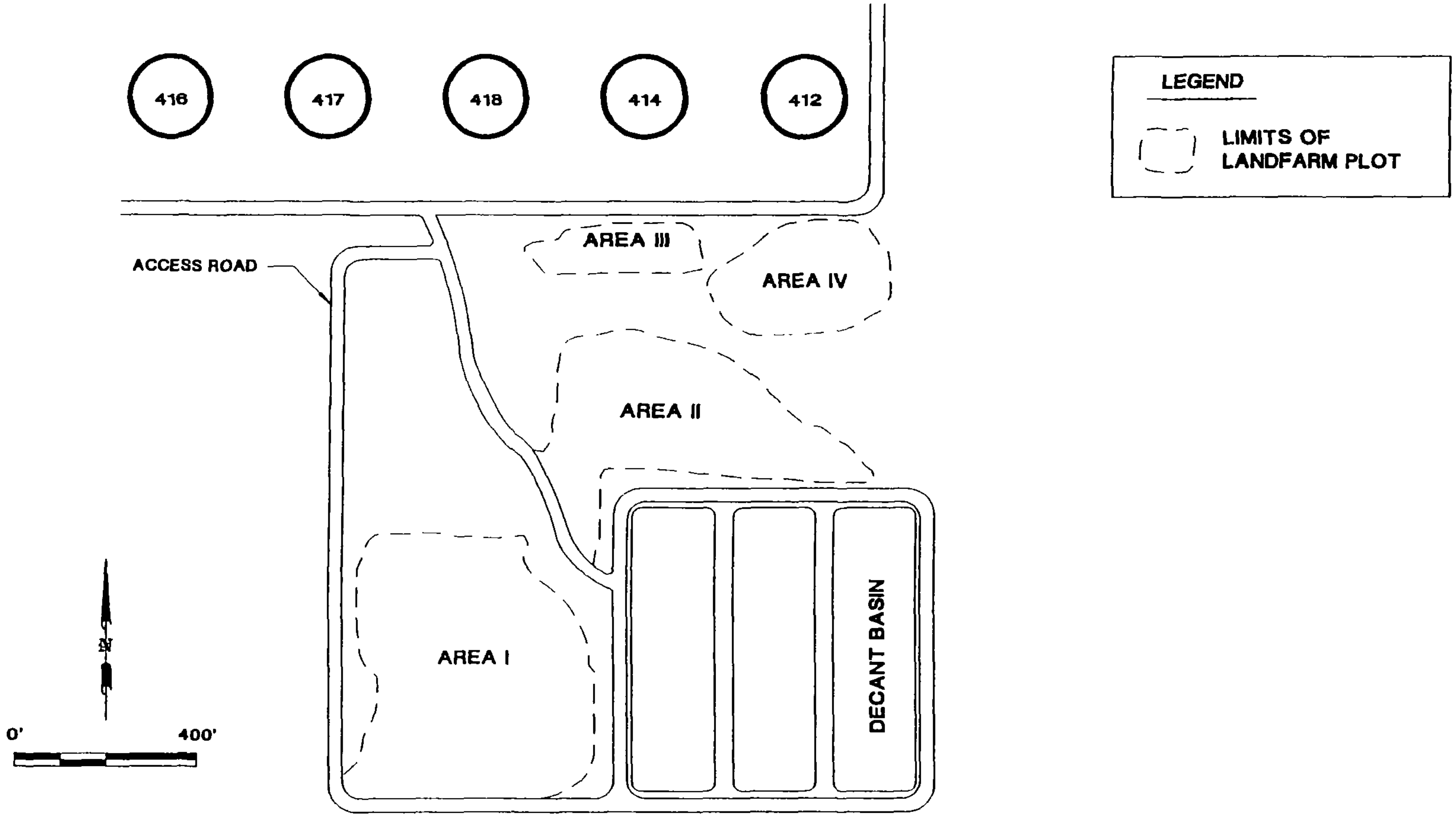


SOURCE: ENSR FIGURE 2-1, 2/8/89

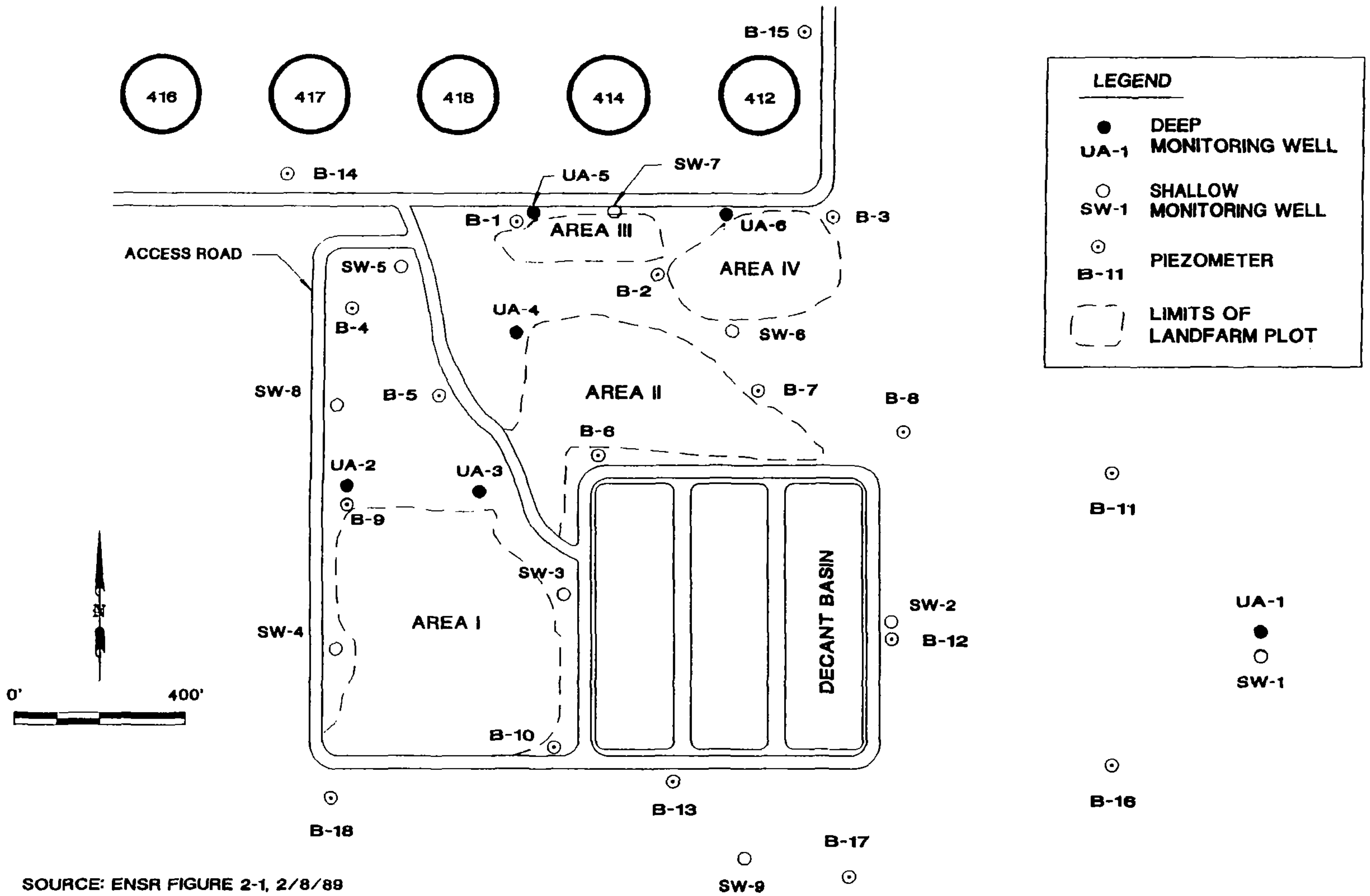
GERAGHTY & MILLER, INC.
Environmental Services

SITE MAP

CLOSURE PLAN FOR THE LAND TREATMENT AREA
UNO-VEN REFINERY
LEMONT, ILLINOIS

FIGURE 1-2

DWG DATE: 6/8/93	PRJCT NO: CI264.02	FILE NO: JT\CI26402	DRAWING: BASEMAP.DW2	CHECKED: JCT	APPROVED: JCT	DRAFTER:



SOURCE: ENSR FIGURE 2-1, 2/8/89

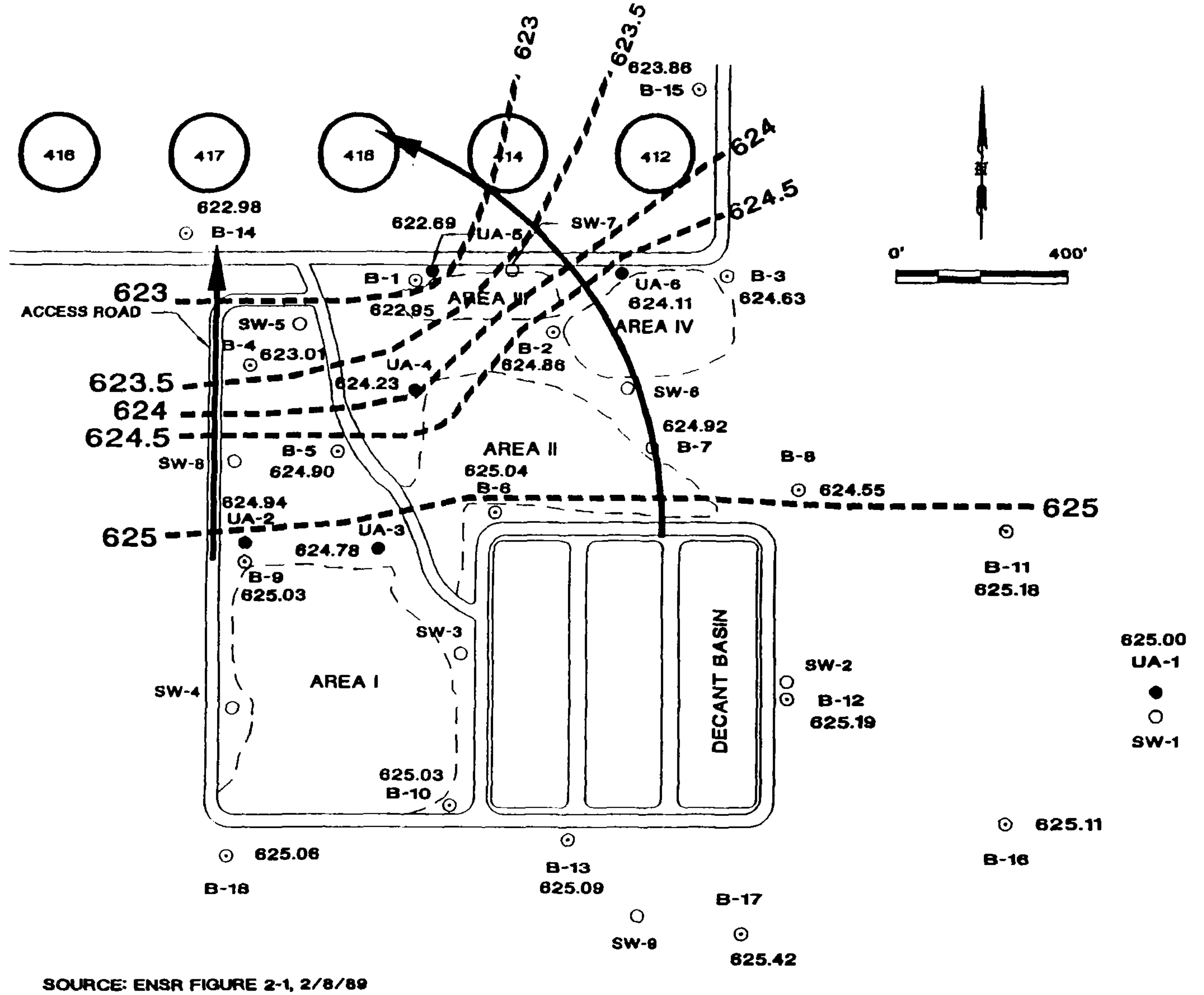
GERAGHTY & MILLER, INC.
Environmental Services

MONITORING WELL LOCATION MAP

CLOSURE PLAN FOR THE LAND TREATMENT AREA
UNO-VEN REFINERY
LEMONT, ILLINOIS

FIGURE 1-3

DW E: 6/8/93	PRJCT NO: C1264.02	FILE NO: JT\C126402	DRAWING: BASEMAP.DW2	CHECKED: JCT	APPROVED: JCT	DRAFT



LEGEND

- DEEP MONITORING WELL (UA-1)
- SHALLOW MONITORING WELL (SW-1)
- PIEZOMETER (B-11)
- LIMITS OF LANDFARM PLOT
- 625 GROUND-WATER ELEVATION CONTOUR
- 625.18 POTENTIOMETRIC SURFACE ELEVATION
- DIRECTION OF GROUND-WATER MOVEMENT

NOTES

1) GROUND-WATER LEVEL CONTOURS ARE BASED SOLELY ON THE BEDROCK PIEZOMETER (B SERIES) WATER LEVEL ELEVATIONS. WATER LEVELS ARE SHOWN FOR THE MONITORING WELLS (UA SERIES) WHICH ARE COMPLETED IN THE LOWER PART OF THE LEMONT DRIFT OVERLYING THE SILURIAN DOLOMITE. THE WATER LEVEL ELEVATIONS FOR THE MONITORING WELLS ARE SHOWN FOR COMPARISON PURPOSES ONLY.

2) WATER LEVELS WERE MEASURED ON MAY 18 & 19, 1993.

SOURCE: ENSR FIGURE 2-1, 2/8/89

GERAGHTY & MILLER, INC.
Environmental Services

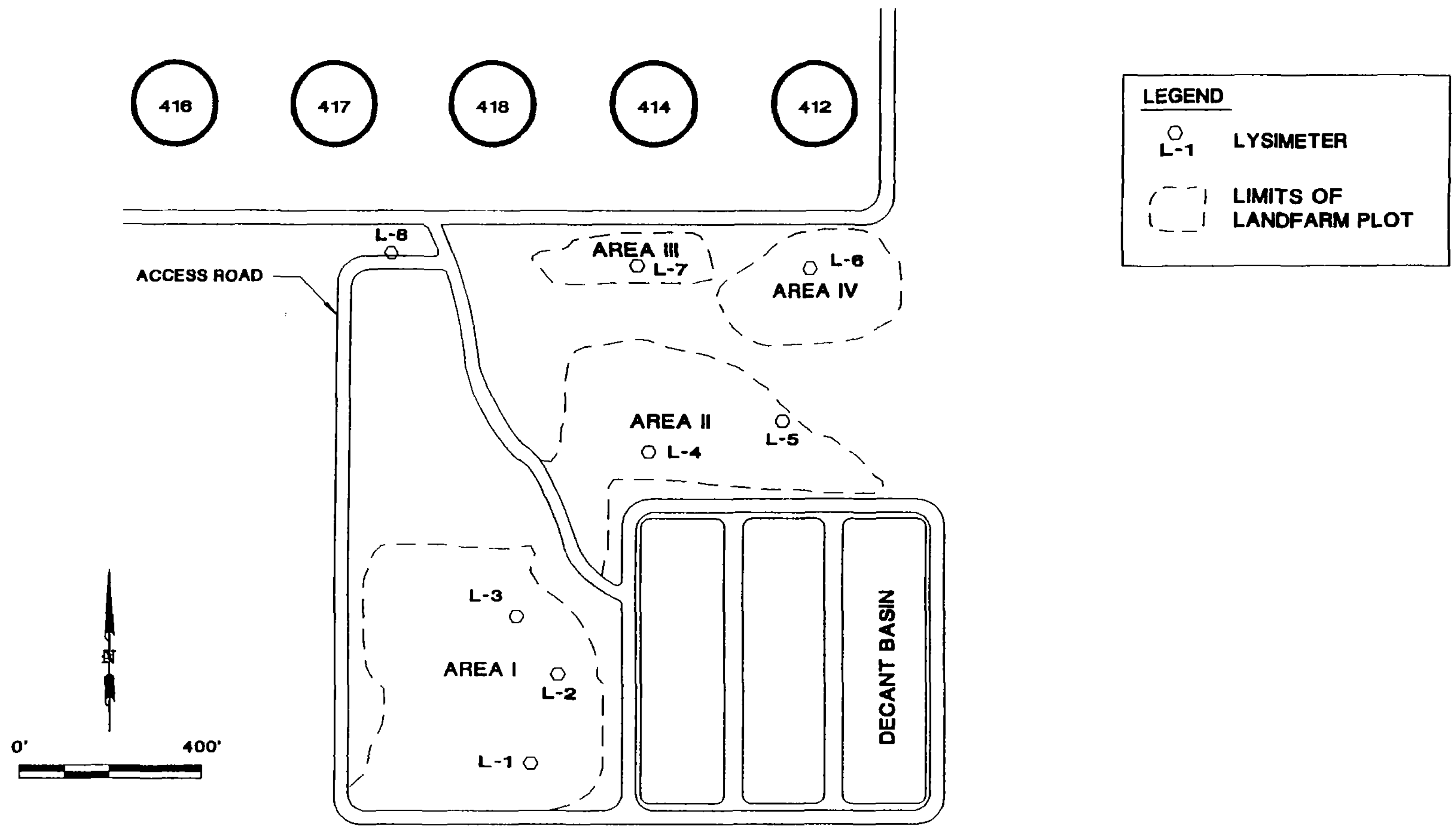
POTENTIOMETRIC SURFACE MAP - UPPERMOST AQUIFER

CLOSURE PLAN FOR THE LAND TREATMENT AREA

UNO-VEN REFINERY
LEMONT, ILLINOIS

FIGURE 3-1

DWG DATE: 6/8/93	PRJCT NO: CI264.02	FILE NO: JT\CI26402	DRAWING: BASEMAP.DW2	CHECKED: JCT	APPROVED: JCT	DRAFTER:



SOURCE: ENSR FIGURE 2-1, 2/8/89

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LYSIMETER LOCATION MAP

CLOSURE PLAN FOR THE LAND TREATMENT AREA

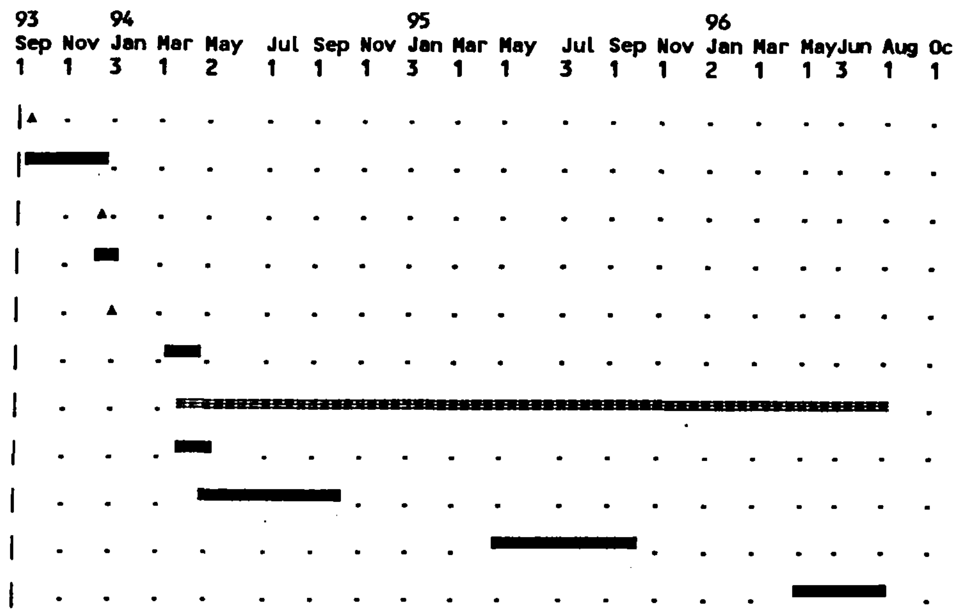
UNO-VEN REFINERY

LEMONT, ILLINOIS

FIGURE 3-2

DWG [illegible]E: 8/25/93	PRJCT NO: CI0264.002	FILE NO: JT\CI26402	DRAWING: SCHEDULE.DW2	CHECKED: JCT	APPROVED: JCT	DRAFT[illegible]

Task Name	Start Date	Duration	End Date
DRAFT CLOSURE PLAN SUBMITTED	9/15/93	0.0	9/15/93
IEPA REVIEW	9/15/93	60.0 d	12/13/93
IEPA COMMENTS RECEIVED	12/13/93	0.0	12/13/93
REVISED CLOSURE PLAN	12/13/93	15.0 d	1/5/94
FINAL CLOSURE PLAN SUBMITTED	1/5/94	0.0	1/5/94
ADDITIONAL SAMPLING	3/10/94	1.0 m	4/11/94
CLOSURE IMPLEMENTATION	4/1/94	589.0 d	8/5/96
EROSION CONTROLS	4/1/94	20.0 d	4/29/94
TILLING (SEASON #1)	5/2/94	5.0 m	10/6/94
TILLING (SEASON #2)	5/1/95	5.0 m	10/5/95
CAP CONSTRUCTION	5/1/96	3.0 m	8/5/96



Detail Task — Summary Task — Baseline
(Progress) — (Progress) — Conflict
(Slack) — (Slack) — Resource delay
Progress shows Percent Achieved on Actual — ▲ Milestone
Scale: 2 weeks per character

TIME LINE Gantt Chart Report, Strip 1, Page 1

GERAGHTY & MILLER, INC.
Environmental Services

PROJECT IMPLEMENTATION SCHEDULE

CLOSURE PLAN FOR THE LAND TREATMENT AREA

UNO–VEN REFINERY

LEMONT, ILLINOIS

FIGURE **8-1**

APPENDIX A

PART A PERMIT APPLICATION

FORM 1 GENERAL

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

GENERAL INFORMATION

Consolidated Permits Program

(Read the "General Instructions" before starting.)

I. EPA I.D. NUMBER

F

LABEL ITEMS

I. EPA I.D. NUMBER — ILD041550567

III. FACILITY NAME — UNION OIL CO OF CALIFORNIA*

V. FACILITY MAILING ADDRESS — NEW AVE & 135TH ST, LEMONT, IL 60439

VI. FACILITY LOCATION — NEW AVE & 135TH ST, LEMONT, IL 60439

GENERAL INSTRUCTIONS

If a preprinted label has been provided, affix it in the designated space. Review the information carefully; if any of it is incorrect, cross through it and enter the correct data in the appropriate fill—in area below. Also, if any of the preprinted data is absent *(the area to the left of the label space lists the information that should appear)*, please provide it in the proper fill—in area(s) below. If the label is complete and correct, you need not complete Items I, III, V, and VI *(except VI-B which must be completed regardless)*. Complete all items if no label has been provided. Refer to the instructions for detailed item descriptions and for the legal authorizations under which this data is collected.

II. POLLUTANT CHARACTERISTICS

INSTRUCTIONS: Complete A through J to determine whether you need to submit any permit application forms to the EPA. If you answer "yes" to any questions, you must submit this form and the supplemental form listed in the parenthesis following the question. Mark "X" in the box in the third column if the supplemental form is attached. If you answer "no" to each question, you need not submit any of these forms. You may answer "no" if your activity is excluded from permit requirements; see Section C of the instructions. See also, Section D of the instructions for definitions of bold—faced terms.

SPECIFIC QUESTIONS	YES	NO	FORM ATTACHED	SPECIFIC QUESTIONS	YES	NO	FORM ATTACHED
A. Is this facility a publicly owned treatment works which results in a discharge to waters of the U.S.? (FORM 2A)		X		B. Does or will this facility *(either existing or proposed)* include a concentrated animal feeding operation or aquatic animal production facility which results in a discharge to waters of the U.S.? (FORM 2B)		X	
C. Is this a facility which currently results in discharges to waters of the U.S. other than those described in A or B above? (FORM 2C)	X			D. Is this a proposed facility *(other than those described in A or B above)* which will result in a discharge to waters of the U.S.? (FORM 2D)		X	
E. Does or will this facility treat, store, or dispose of hazardous wastes? (FORM 3)	X		X	F. Do you or will you inject at this facility industrial or municipal effluent below the lowermost stratum containing, within one quarter mile of the well bore, underground sources of drinking water? (FORM 4)		X	
G. Do you or will you inject at this facility any produced water or other fluids which are brought to the surface in connection with conventional oil or natural gas production, inject fluids used for enhanced recovery of oil or natural gas, or inject fluids for storage of liquid hydrocarbons? (FORM 4)		X		H. Do you or will you inject at this facility fluids for special processes such as mining of sulfur by the Frasch process, solution mining of minerals, in situ combustion of fossil fuel, or recovery of geothermal energy? (FORM 4)		X	
I. Is this facility a proposed stationary source which is one of the 28 industrial categories listed in the instructions and which will potentially emit 100 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5)		X		J. Is this facility a proposed stationary source which is NOT one of the 28 industrial categories listed in the instructions and which will potentially emit 250 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5)		X	

III. NAME OF FACILITY

1 SKIP UNION OIL CO. OF CALIF.: CHICAGO REFINERY

IV. FACILITY CONTACT

A. NAME & TITLE (last, first, & title)	B. PHONE (area code & no.)
2 BRUCKERT D. W. SUPV. ENVIR. SERV.	312 257 7761

V. FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX

3 135th STREET & NEW AVENUE

B. CITY OR TOWN	C. STATE	D. ZIP CODE
4 LEMONT	IL	60439

VI. FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER

5 135th STREET & NEW AVENUE

B. COUNTY NAME

ILL

C. CITY OR TOWN	D. STATE	E. ZIP CODE	F. COUNTY CODE (if known)
6 LEMONT	IL	60439	

EPA Form 3510-1 (6-80)

CONTINUE ON REVERSE

CONTINUED FROM THE FRONT

VII. SIC CODES (4-digit, in order of priority)

A. FIRST	(specify)	B. SECOND	(specify)
7 2911	Petroleum Refining	7	

C. THIRD	(specify)	D. FOURTH	(specify)
7		7	

VIII. OPERATOR INFORMATION

A. NAME: 8 UNION OIL CO. OF CALIF.: CHICAGO REFINERY

B. Is the name listed in Item VIII-A also the owner? ☒ YES ☐ NO

C. STATUS OF OPERATOR (Enter the appropriate letter into the answer box; if "Other", specify.)

F = FEDERAL
S = STATE
P = PRIVATE
M = PUBLIC (other than federal or state)
O = OTHER (specify)

Answer: P (specify)

D. PHONE (area code & no.): A 312 257 7761

E. STREET OR P.O. BOX: 135th STREET & NEW AVENUE

F. CITY OR TOWN	G. STATE	H. ZIP CODE
B LEMONT	IL	60439

IX. INDIAN LAND

Is the facility located on Indian lands? ☐ YES ☒ NO

X. EXISTING ENVIRONMENTAL PERMITS

A. NPDES (Discharges to Surface Water)	D. PSD (Air Emissions from Proposed Sources)
9 N IL0001589	9 P

B. UIC (Underground Injection of Fluids)	E. OTHER (specify)	(specify)
9 U	9	

C. RCRA (Hazardous Wastes)	E. OTHER (specify)	(specify)
9 R	9	

XI. MAP

Attach to this application a topographic map of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in the map area. See instructions for precise requirements.

XII. NATURE OF BUSINESS (provide a brief description)

A - Petroleum refining and related activities.

B - Process crude oil to finished petroleum products such as gasoline, fuel oils, and other miscellaneous products.

XIII. CERTIFICATION (see instructions)

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME & OFFICIAL TITLE (type or print)	B. SIGNATURE	C. DATE SIGNED
J. Eliskalns, Manager Chicago Refinery	[signature]	7-13-84

COMMENTS FOR OFFICIAL USE ONLY

C

EPA Form 3510-1 (6-80) REVERSE

FORM 3 RCRA

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

HAZARDOUS WASTE PERMIT APPLICATION

Consolidated Permits Program

(This information is required under Section 3005 of RCRA.)

I. EPA I.D. NUMBER

F I L D 0 4 1 5 5 0 5 6 7

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED (yr., mo., & day)	COMMENTS

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below *(mark one box only)* to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA I.D. Number, or if this is a revised application, enter your facility's EPA I.D. Number in Item I above.

A. FIRST APPLICATION *(place an "X" below and provide the appropriate date)*

[X] 1. EXISTING FACILITY *(See instructions for definition of "existing" facility. Complete item below.)*

[ ] 2. NEW FACILITY *(Complete item below.)*

8 | YR. 73 | MO. 11 | DAY 09 | FOR EXISTING FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

YR. | MO. | DAY | FOR NEW FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR IS EXPECTED TO BEGIN

B. REVISED APPLICATION *(place an "X" below and complete Item I above)*

[X] 1. FACILITY HAS INTERIM STATUS

[ ] 2. FACILITY HAS A RCRA PERMIT

III. PROCESSES – CODES AND DESIGN CAPACITIES

A. PROCESS CODE — Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code(s) in the space provided. If a process will be used that is not included in the list of codes below, then describe the process *(including its design capacity)* in the space provided on the form *(Item III-C)*.

B. PROCESS DESIGN CAPACITY — For each code entered in column A enter the capacity of the process.
1. AMOUNT — Enter the amount.
2. UNIT OF MEASURE — For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER *(barrel, drum, etc.)*	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D79	GALLONS OR LITERS
LANDFILL	D80	ACRE-FEET *(the volume that would cover one acre to a depth of one foot)* OR HECTARE-METER
LAND APPLICATION	D81	ACRES OR HECTARES
OCEAN DISPOSAL	D82	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D83	GALLONS OR LITERS
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR
OTHER *(Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Item III-C.)*	T04	GALLONS PER DAY OR LITERS PER DAY

UNIT OF MEASURE	UNIT OF MEASURE CODE	UNIT OF MEASURE	UNIT OF MEASURE CODE	UNIT OF MEASURE	UNIT OF MEASURE CODE
GALLONS	G	LITERS PER DAY	V	ACRE-FEET	A
LITERS	L	TONS PER HOUR	D	HECTARE-METER	F
CUBIC YARDS	Y	METRIC TONS PER HOUR	W	ACRES	B
CUBIC METERS	C	GALLONS PER HOUR	E	HECTARES	Q
GALLONS PER DAY	U	LITERS PER HOUR	H		

EXAMPLE FOR COMPLETING ITEM III *(shown in line numbers X-1 and X-2 below)*: A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

C | DUP | T/A C | I

LINE NUMBER	A. PROCESS CODE (from list above)	B. 1. AMOUNT (specify)	B. 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
X-1	S 0 2	600	G	
X-2	T 0 3	20	E	
1	D 8 1	13.3	B	
2				
3				
4				
5				
6				
7				
8				
9				
10				

II. PROCESSES *(continued)*

SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESSES *(code "T04")*. FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY.

IV. DESCRIPTION OF HAZARDOUS WASTES

EPA HAZARDOUS WASTE NUMBER — Enter the four-digit number from 40 CFR, Subpart D for each listed hazardous waste you will handle. If you handle hazardous wastes which are not listed in 40 CFR, Subpart D, enter the four-digit number*(s)* from 40 CFR, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.

ESTIMATED ANNUAL QUANTITY — For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non-listed waste*(s)* that will be handled which possess that characteristic or contaminant.

UNIT OF MEASURE — For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

PROCESSES

1. PROCESS CODES:

For listed hazardous waste: For each listed hazardous waste entered in column A select the code*(s)* from the list of process codes contained in Item III to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non-listed hazardous wastes: For each characteristic or toxic contaminant entered in column A, select the code*(s)* from the list of process codes contained in Item III to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed hazardous wastes that possess that characteristic or toxic contaminant.

Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code*(s)*.

2. PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER — Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. Select one of the EPA Hazardous Waste Numbers and enter it in column A. On the same line complete columns B, C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.
3. Repeat step 2 for each other EPA Hazardous Waste Number that can be used to describe the hazardous waste.

EXAMPLE FOR COMPLETING ITEM IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* — A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

LINE NO.	A. EPA HAZARD. WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
X-1	K 0 5 4	900	P	T 0 3 D 8 0	
X-2	D 0 0 2	400	P	T 0 3 D 8 0	
X-3	D 0 0 1	100	P	T 0 3 D 8 0	
X-4	D 0 0 2				included with above

CONTINUE ON PAGE 3

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

Form Approved OMB No. 158-S80004

EPA I.D. NUMBER (enter from page 1)		FOR OFFICIAL USE ONLY	
W I L D 0 4 1 5 5 0 5 6 7	1	W DUP	2 DUP

IV. DESCRIPTION OF HAZARDOUS WASTES (continued)

LINE NO.	A. EPA HAZARD. WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)				2. PROCESS DESCRIPTION (if a code is not entered in D(1))
1	K051	13 Dry Tons	T	D81				API Separator Sludge
2	K049	Unknown	T	D81				Slop Oil Emulsions; possible waste to be treated
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

EPA Form 3510-3 (6-80)

CONTINUE ON REVERSE

(enter "A", "B", "C", etc. behind the "3" to identify photocopied pages)

Continued from the front.

IV. DESCRIPTION OF HAZARDOUS WASTES (continued)

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM ITEM D(1) ON PAGE 3.

EPA I.D. NO. (enter from page 1)

F I L D 0 4 1 5 5 0 5 6 7 | T/A C 16

V. FACILITY DRAWING

All existing facilities must include in the space provided on page 5 a scale drawing of the facility (see instructions for more detail).

VI. PHOTOGRAPHS

All existing facilities must include photographs (aerial or ground–level) that clearly delineate all existing structures; existing storage, atment and disposal areas; and sites of future storage, treatment or disposal areas (see instructions for more detail).

VII. FACILITY GEOGRAPHIC LOCATION

LATITUDE (degrees, minutes, & seconds)	LONGITUDE (degrees, minutes, & seconds)
41 39 00	89 03 30

VIII. FACILITY OWNER

☐ A. If the facility owner is also the facility operator as listed in Section VIII on Form 1, "General Information", place an "X" in the box to the left and skip to Section IX below.

B. If the facility owner is not the facility operator as listed in Section VIII on Form 1, complete the following items:

1. NAME OF FACILITY'S LEGAL OWNER	2. PHONE NO. (area code & no.)
E	

3. STREET OR P.O. BOX	4. CITY OR TOWN	5. ST.	6. ZIP CODE
F	G		

IX. OWNER CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME (print or type)	B. SIGNATURE	C. DATE SIGNED
A. J. Eliskalns, Manager Chicago Refinery	[signature]	7-13-84

X. OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME (print or type)	B. SIGNATURE	C. DATE SIGNED

CONTINUE ON PAGE

V. FACILITY DRAWING (see page 4)

See Attached Figures A-1 and A-2.

A-1: Facility Location Map

A-2: Facility Base Map

APPENDIX B

DESIGN CALCULATION: HELP MODEL

DEFAULT SOIL AND DESIGN DATA INPUT

Title: UNO-VEN CLOSURE PLAN
EXISTING CONDITIONS
LANDFARM AREA 1

Do you want the program to initialize the soil water? Y

Number of layers: 1

Layer data:

Layer 1
(a) thickness 60" inches
(b) layer type 1 (1 or 2)
(c) liner leakage fraction (only for layer type 4) ________ (0 to 1)
(d) soil texture number 5 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) N (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ________ vol/vol
(must be between wilting point and porosity)

Layer 2
(a) thickness ________ inches
(b) layer type ________ (1 to 4)
(c) liner leakage fraction (only for layer type 4) ________ (0 to 1)
(d) soil texture number ________ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ________ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ________ vol/vol
(must be between wilting point and porosity)

Layer 3
(a) thickness ________ inches
(b) layer type ________
(c) liner leakage fraction (only for layer type 4) ________ (0 to 1)
(d) soil texture number ________ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ________ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ________ vol/vol
(must be between wilting point and porosity)

	Layer 4		Layer 5		Layer 6
(a)		(a)		(a)	
(b)		(b)		(b)	
(c)		(c)		(c)	
(d)		(d)		(d)	
(e)		(e)		(e)	
(f)		(f)		(f)	

Layer 7		Layer 8		Layer 9	
(a)	____	(a)	____	(a)	____
(b)	____	(b)	____	(b)	____
(c)	____	(c)	____	(c)	____
(d)	____	(d)	____	(d)	____
(e)	____	(e)	____	(e)	____
(f)	____	(f)	____	(f)	____

Layer 10		Layer 11		Layer 12	
(a)	____	(a)	____	(a)	____
(b)	____	(b)	____	(b)	____
(c)	____	(c)	____	(c)	____
(d)	____	(d)	____	(d)	____
(e)	____	(e)	____	(e)	____
(f)	____	(f)	____	(f)	____

If soil texture number of layer 1 is between 1 and 15, enter:
Type of vegetation: BARE GROUND (1 to 5)
SCS runoff curve number (optional): ____ (0 to 100)

If the soil texture number of layer 1 is between 16 and 20, enter:
SCS runoff curve number: ____ (0 to 100)

If landfill is open, enter potential runoff fraction: N (0 to 1)

Surface area: 239580 square feet

Slope of top liner/drain system: ____ percent
Distance from crest to drain in top liner/drain system: ____ feet

Slope of second liner/drain system: ____ percent
Distance from crest to drain in second liner/drain system: ____ feet

Slope of third liner/drain system: ____ percent
Distance from crest to drain in third liner/drain system: ____ feet

Slope of fourth liner/drain system: ____ percent
Distance from crest to drain in fourth liner/drain system: ____ feet

Initial quantity of snow or ice water on surface (not asked if program is to initialize the soil water): ____ inches

* If soil texture number is 19:

(a) wilting point ____ vol/vol
(b) field capacity ____ vol/vol
(c) porosity ____ vol/vol
(d) saturated hydraulic conductivity ____ cm/sec

If soil texture number is 20:

(a) wilting point ____ vol/vol
(b) field capacity ____ vol/vol
(c) porosity ____ vol/vol
(d) saturated hydraulic conductivity ____ cm/sec

```
*****************************************************************************
*****************************************************************************

UNO-VEN CLOSURE PLAN
EXISTING CONDITIONS
LANDFARM AREA 1

*****************************************************************************
*****************************************************************************



                              BARE GROUND


                               LAYER  1
                               --------

                      VERTICAL PERCOLATION LAYER
  THICKNESS                              =    60.00 INCHES
  POROSITY                               =     0.4570 VOL/VOL
  FIELD CAPACITY                         =     0.1309 VOL/VOL
  WILTING POINT                          =     0.0580 VOL/VOL
  INITIAL SOIL WATER CONTENT             =     0.1309 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY       =     0.001000000047 CM/SEC



                        GENERAL SIMULATION DATA
                        -----------------------

  SCS RUNOFF CURVE NUMBER                =      83.31
  TOTAL AREA OF COVER                    =  239580. SQ FT
  EVAPORATIVE ZONE DEPTH                 =       8.00 INCHES
  UPPER LIMIT VEG. STORAGE               =       3.6560 INCHES
  INITIAL VEG. STORAGE                   =       1.3966 INCHES
  INITIAL SNOW WATER CONTENT             =       0.0000 INCHES
  INITIAL TOTAL WATER STORAGE IN
    SOIL AND WASTE LAYERS                =       7.8540 INCHES

            SOIL WATER CONTENT INITIALIZED BY PROGRAM.


                          CLIMATOLOGICAL DATA
                          -------------------

  DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
```

SOLAR RADIATION FOR CHICAGO ILLINOIS

MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 128
END OF GROWING SEASON (JULIAN DATE) = 282

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.40	26.00	36.00	48.80	59.10	68.60
73.00	71.90	64.70	53.50	39.80	27.70

****

ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.35	705763.	100.00
RUNOFF	0.170	3402.	0.48
EVAPOTRANSPIRATION	24.465	488442.	69.21
PERCOLATION FROM LAYER 1	10.7073	213771.	30.29
CHANGE IN WATER STORAGE	0.007	148.	0.02
SOIL WATER AT START OF YEAR	12.87	256977.	
SOIL WATER AT END OF YEAR	12.88	257126.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.62	791013.	100.00
RUNOFF	1.953	38982.	4.93
EVAPOTRANSPIRATION	23.007	459344.	58.07
PERCOLATION FROM LAYER 1	12.3977	247521.	31.29

CHANGE IN WATER STORAGE	2.262	45166.	5.71
SOIL WATER AT START OF YEAR	12.88	257126.	
SOIL WATER AT END OF YEAR	13.22	264017.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.92	38275.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.56	530270.	100.00
RUNOFF	0.815	16263.	3.07
EVAPOTRANSPIRATION	18.416	367666.	69.34
PERCOLATION FROM LAYER 1	11.3975	227551.	42.91
CHANGE IN WATER STORAGE	-4.068	-81210.	-15.31
SOIL WATER AT START OF YEAR	13.22	264017.	
SOIL WATER AT END OF YEAR	11.07	221083.	
SNOW WATER AT START OF YEAR	1.92	38275.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.50	648863.	100.00
RUNOFF	0.364	7275.	1.12
EVAPOTRANSPIRATION	22.462	448450.	69.11

DEFAULT SOIL AND DESIGN DATA INPUT

Title: UNO-VEN CLOSURE PLAN

FINAL COVER SYSTEM DESIGN

LANDFARM AREA 2

Do you want the program to initialize the soil water? Y

Number of layers: 2

Layer data:

Layer 1
(a) thickness 30" inches
(b) layer type 1 (1 or 2)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number 9 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) Y (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

Layer 2
(a) thickness 60" inches
(b) layer type 1 (1 to 4)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number 5 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) N (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

Layer 3
(a) thickness ______ inches
(b) layer type ______
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number ______ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ______ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

	Layer 4		Layer 5		Layer 6
(a)	______	(a)	______	(a)	______
(b)	______	(b)	______	(b)	______
(c)	______	(c)	______	(c)	______
(d)	______	(d)	______	(d)	______
(e)	______	(e)	______	(e)	______
(f)	______	(f)	______	(f)	______

Layer 7		Layer 8		Layer 9	
(a)		(a)		(a)	
(b)		(b)		(b)	
(c)		(c)		(c)	
(d)		(d)		(d)	
(e)		(e)		(e)	
(f)		(f)		(f)	

Layer 10		Layer 11		Layer 12	
(a)		(a)		(a)	
(b)		(b)		(b)	
(c)		(c)		(c)	
(d)		(d)		(d)	
(e)		(e)		(e)	
(f)		(f)		(f)	

If soil texture number of layer 1 is between 1 and 15, enter:
Type of vegetation: FAIR (1 to 5)
SCS runoff curve number (optional): ______ (0 to 100)

If the soil texture number of layer 1 is between 16 and 20, enter:
SCS runoff curve number: ______ (0 to 100)

If landfill is open, enter potential runoff fraction: N (0 to 1)

Surface area: 182032 square feet

Slope of top liner/drain system: ______ percent
Distance from crest to drain in top liner/drain system: ______ feet

Slope of second liner/drain system: ______ percent
Distance from crest to drain in second liner/drain system: ______ feet

Slope of third liner/drain system: ______ percent
Distance from crest to drain in third liner/drain system: ______ feet

Slope of fourth liner/drain system: ______ percent
Distance from crest to drain in fourth liner/drain system: ______ feet

Initial quantity of snow or ice water on surface (not asked if program is to initialize the soil water): ______ inches

* If soil texture number is 19:

(a) wilting point ______ vol/vol
(b) field capacity ______ vol/vol
(c) porosity ______ vol/vol
(d) saturated hydraulic conductivity ______ cm/sec

If soil texture number is 20:

(a) wilting point ______ vol/vol
(b) field capacity ______ vol/vol
(c) porosity ______ vol/vol
(d) saturated hydraulic conductivity ______ cm/sec

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UNO-VEN CLOSURE PLAN
FINAL COVER SYSTEM DESIGN
LANDFARM AREA 2

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	30.00 INCHES
POROSITY	=	0.4096 VOL/VOL
FIELD CAPACITY	=	0.2466 VOL/VOL
WILTING POINT	=	0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2466 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000028500002 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	60.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	81.48
TOTAL AREA OF COVER	=	182952. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES

UPPER LIMIT VEG. STORAGE = 8.1920 INCHES
INITIAL VEG. STORAGE = 5.7523 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 15.2520 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CHICAGO ILLINOIS

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 128
END OF GROWING SEASON (JULIAN DATE) = 282

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.40	26.00	36.00	48.80	59.10	68.60
73.00	71.90	64.70	53.50	39.80	27.70

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.35	538946.	100.00
RUNOFF	1.884	28728.	5.33
EVAPOTRANSPIRATION	28.298	431436.	80.05
PERCOLATION FROM LAYER 2	4.4419	67722.	12.57
CHANGE IN WATER STORAGE	0.725	11060.	2.05
SOIL WATER AT START OF YEAR	19.51	297387.	
SOIL WATER AT END OF YEAR	20.23	308448.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.62	604046.	100.00
RUNOFF	6.612	100803.	16.69
EVAPOTRANSPIRATION	27.159	414070.	68.55
PERCOLATION FROM LAYER 2	4.1749	63650.	10.54
CHANGE IN WATER STORAGE	1.674	25523.	4.23
SOIL WATER AT START OF YEAR	20.23	308448.	
SOIL WATER AT END OF YEAR	19.92	303650.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.99	30320.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.56	404934.	100.00
RUNOFF	2.621	39963.	9.87
EVAPOTRANSPIRATION	21.490	327636.	80.91
PERCOLATION FROM LAYER 2	6.7442	102822.	25.39
CHANGE IN WATER STORAGE	-4.295	-65487.	-16.17
SOIL WATER AT START OF YEAR	19.92	303650.	
SOIL WATER AT END OF YEAR	17.61	268483.	
SNOW WATER AT START OF YEAR	1.99	30320.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.50	495495.	100.00
RUNOFF	2.863	43646.	8.81
EVAPOTRANSPIRATION	26.052	397187.	80.16
PERCOLATION FROM LAYER 2	1.2377	18870.	3.81
CHANGE IN WATER STORAGE	2.348	35792.	7.22
SOIL WATER AT START OF YEAR	17.61	268483.	
SOIL WATER AT END OF YEAR	19.96	304276.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	36.38	554649.	100.00
RUNOFF	6.008	91591.	16.51
EVAPOTRANSPIRATION	27.276	415846.	74.97
PERCOLATION FROM LAYER 2	1.8031	27490.	4.96
CHANGE IN WATER STORAGE	1.294	19722.	3.56
SOIL WATER AT START OF YEAR	19.96	304276.	
SOIL WATER AT END OF YEAR	21.25	323997.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.98	1.52	3.03	4.08	3.25	4.36
	3.05	3.67	3.18	1.74	1.95	2.27
STD. DEVIATIONS	1.43	0.90	1.84	1.02	1.42	0.99
	1.57	2.52	2.68	0.36	0.77	1.06
RUNOFF						
TOTALS	0.077	0.015	0.720	0.615	0.055	0.420
	0.451	0.665	0.828	0.119	0.005	0.026
STD. DEVIATIONS	0.158	0.021	0.819	0.583	0.084	0.506
	0.445	1.236	1.578	0.117	0.012	0.039
EVAPOTRANSPIRATION						
TOTALS	0.529	0.942	1.751	3.486	3.522	4.595
	3.583	2.523	2.023	1.382	1.055	0.665
STD. DEVIATIONS	0.081	0.220	0.335	0.213	1.144	0.829
	1.454	0.893	1.198	0.463	0.362	0.160
PERCOLATION FROM LAYER 2						
TOTALS	0.1314	0.1750	0.4926	0.6028	0.5082	0.4152
	0.3529	0.2801	0.2217	0.1931	0.1611	0.1464
STD. DEVIATIONS	0.0423	0.0589	0.3927	0.4841	0.3744	0.2889
	0.2164	0.1532	0.1089	0.0861	0.0659	0.0551

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	34.08 (4.915)	519614.	100.00
RUNOFF	3.998 (2.152)	60946.	11.73

EVAPOTRANSPIRATION	26.055	(2.673)	397235.	76.45
PERCOLATION FROM LAYER 2	3.6804	(2.2194)	56111.	10.80
CHANGE IN WATER STORAGE	0.349	(2.662)	5322.	1.02

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.48	53056.1
RUNOFF	2.423	36941.0
PERCOLATION FROM LAYER 2	0.0484	737.2
SNOW WATER	3.37	51382.6

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4061
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1344

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	10.14	0.3381
2	11.11	0.1851
SNOW WATER	0.00	

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PERCOLATION FROM LAYER 1	7.6022	151779.	23.39
CHANGE IN WATER STORAGE	2.072	41359.	6.37
SOIL WATER AT START OF YEAR	11.07	221083.	
SOIL WATER AT END OF YEAR	13.15	262441.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	36.38	726327.	100.00
RUNOFF	1.781	35556.	4.90
EVAPOTRANSPIRATION	21.444	428126.	58.94
PERCOLATION FROM LAYER 1	12.0112	239804.	33.02
CHANGE IN WATER STORAGE	1.144	22841.	3.14
SOIL WATER AT START OF YEAR	13.15	262441.	
SOIL WATER AT END OF YEAR	14.29	285283.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

PRECIPITATION

TOTALS	1.98	1.52	3.03	4.08	3.25	4.36
	3.05	3.67	3.18	1.74	1.95	2.27
STD. DEVIATIONS	1.43	0.90	1.84	1.02	1.42	0.99
	1.57	2.52	2.68	0.36	0.77	1.06

RUNOFF

TOTALS	0.011	0.002	0.170	0.124	0.015	0.082
	0.091	0.256	0.261	0.001	0.000	0.002
STD. DEVIATIONS	0.024	0.005	0.228	0.192	0.033	0.116
	0.115	0.554	0.538	0.003	0.000	0.004

EVAPOTRANSPIRATION

TOTALS	0.553	0.969	1.661	2.924	2.961	3.278
	2.245	2.232	1.776	1.473	1.160	0.727
STD. DEVIATIONS	0.099	0.268	0.392	0.243	0.995	0.910
	0.520	0.744	0.981	0.418	0.453	0.200

PERCOLATION FROM LAYER 1

TOTALS	0.7518	0.8519	1.5956	0.9530	1.0335	0.8325
	0.9728	0.6816	1.1420	0.8524	0.4854	0.6706
STD. DEVIATIONS	0.4054	0.5206	1.3620	0.5074	0.6069	0.3348
	0.6045	0.2513	0.7603	0.5996	0.2042	0.4155

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	34.08	(4.915)	680447.	100.00
RUNOFF	1.017	(0.813)	20295.	2.98
EVAPOTRANSPIRATION	21.959	(2.261)	438406.	64.43
PERCOLATION FROM LAYER 1	10.8232	(1.9110)	216085.	31.76
CHANGE IN WATER STORAGE	0.284	(2.591)	5661.	0.83

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.48	69478.2
RUNOFF	1.180	23558.9
PERCOLATION FROM LAYER 1	0.1979	3951.7
SNOW WATER	3.28	65505.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3377

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0575

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	14.29	0.2382

SNOW WATER 0.00

DEFAULT SOIL AND DESIGN DATA INPUT

Title: UNO-VEN CLOSURE PLAN
FINAL COVER SYSTEM DESIGN
LANDFARM AREA 1

Do you want the program to initialize the soil water? Y

Number of layers: 2

Layer data:

Layer 1

(a) thickness	36"	inches
(b) layer type	1	(1 or 2)
(c) liner leakage fraction (only for layer type 4)		(0 to 1)
(d) soil texture number	9	(1 to 20)*
(e) compacted? (only for soil textures 1 to 15)	Y	(Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) (must be between wilting point and porosity)		vol/vol

Layer 2

(a) thickness	60"	inches
(b) layer type	1	(1 to 4)
(c) liner leakage fraction (only for layer type 4)		(0 to 1)
(d) soil texture number	5	(1 to 20)*
(e) compacted? (only for soil textures 1 to 15)	N	(Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) (must be between wilting point and porosity)		vol/vol

Layer 3

(a) thickness		inches
(b) layer type		
(c) liner leakage fraction (only for layer type 4)		(0 to 1)
(d) soil texture number		(1 to 20)*
(e) compacted? (only for soil textures 1 to 15)		(Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) (must be between wilting point and porosity)		vol/vol

	Layer 4	Layer 5	Layer 6
(a)			
(b)			
(c)			
(d)			
(e)			
(f)			

Layer 7	Layer 8	Layer 9
(a) ______	(a) ______	(a) ______
(b) ______	(b) ______	(b) ______
(c) ______	(c) ______	(c) ______
(d) ______	(d) ______	(d) ______
(e) ______	(e) ______	(e) ______
(f) ______	(f) ______	(f) ______

Layer 10	Layer 11	Layer 12
(a) ______	(a) ______	(a) ______
(b) ______	(b) ______	(b) ______
(c) ______	(c) ______	(c) ______
(d) ______	(d) ______	(d) ______
(e) ______	(e) ______	(e) ______
(f) ______	(f) ______	(f) ______

If soil texture number of layer 1 is between 1 and 15, enter:
Type of vegetation: FAIR (1 to 5)
SCS runoff curve number (optional): ______ (0 to 100)

If the soil texture number of layer 1 is between 16 and 20, enter:
SCS runoff curve number: ______ (0 to 100)

If landfill is open, enter potential runoff fraction: N (0 to 1)

Surface area: 239580 square feet

Slope of top liner/drain system: ______ percent
Distance from crest to drain in top liner/drain system: ______ feet

Slope of second liner/drain system: ______ percent
Distance from crest to drain in second liner/drain system: ______ feet

Slope of third liner/drain system: ______ percent
Distance from crest to drain in third liner/drain system: ______ feet

Slope of fourth liner/drain system: ______ percent
Distance from crest to drain in fourth liner/drain system: ______ feet

Initial quantity of snow or ice water on surface (not asked if program is to initialize the soil water): ______ inches

* If soil texture number is 19:		If soil texture number is 20:	
(a) wilting point ______	vol/vol	(a) wilting point ______	vol/vol
(b) field capacity ______	vol/vol	(b) field capacity ______	vol/vol
(c) porosity ______	vol/vol	(c) porosity ______	vol/vol
(d) saturated hydraulic conductivity ______	cm/sec	(d) saturated hydraulic conductivity ______	cm/sec

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UNO-VEN CLOSURE PLAN
FINAL COVER SYSTEM DESIGN
LANDFARM AREA 1

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	30.00 INCHES
POROSITY	=	0.4096 VOL/VOL
FIELD CAPACITY	=	0.2466 VOL/VOL
WILTING POINT	=	0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2466 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000028500002 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	60.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	81.48
TOTAL AREA OF COVER	=	239580. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES

UPPER LIMIT VEG. STORAGE	=	8.1920 INCHES
INITIAL VEG. STORAGE	=	5.7523 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	15.2520 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CHICAGO ILLINOIS

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	128
END OF GROWING SEASON (JULIAN DATE)	=	282

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.40	26.00	36.00	48.80	59.10	68.60
73.00	71.90	64.70	53.50	39.80	27.70

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.35	705763.	100.00
RUNOFF	1.884	37620.	5.33
EVAPOTRANSPIRATION	28.298	564976.	80.05
PERCOLATION FROM LAYER 2	4.4419	88683.	12.57
CHANGE IN WATER STORAGE	0.725	14484.	2.05
SOIL WATER AT START OF YEAR	19.51	389436.	
SOIL WATER AT END OF YEAR	20.23	403919.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.62	791013.	100.00
RUNOFF	6.612	132004.	16.69
EVAPOTRANSPIRATION	27.159	542235.	68.55
PERCOLATION FROM LAYER 2	4.1749	83351.	10.54
CHANGE IN WATER STORAGE	1.674	33423.	4.23
SOIL WATER AT START OF YEAR	20.23	403919.	
SOIL WATER AT END OF YEAR	19.92	397638.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.99	39705.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.56	530270.	100.00
RUNOFF	2.621	52332.	9.87
EVAPOTRANSPIRATION	21.490	429047.	80.91
PERCOLATION FROM LAYER 2	6.7442	134648.	25.39
CHANGE IN WATER STORAGE	-4.295	-85757.	-16.17
SOIL WATER AT START OF YEAR	19.92	397638.	
SOIL WATER AT END OF YEAR	17.61	351585.	
SNOW WATER AT START OF YEAR	1.99	39705.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.50	648863.	100.00
RUNOFF	2.863	57155.	8.81
EVAPOTRANSPIRATION	26.052	520126.	80.16
PERCOLATION FROM LAYER 2	1.2377	24711.	3.81
CHANGE IN WATER STORAGE	2.348	46871.	7.22
SOIL WATER AT START OF YEAR	17.61	351585.	
SOIL WATER AT END OF YEAR	19.96	398456.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	36.38	726327.	100.00
RUNOFF	6.008	119941.	16.51
EVAPOTRANSPIRATION	27.276	544561.	74.97
PERCOLATION FROM LAYER 2	1.8031	35999.	4.96
CHANGE IN WATER STORAGE	1.294	25826.	3.56
SOIL WATER AT START OF YEAR	19.96	398456.	
SOIL WATER AT END OF YEAR	21.25	424282.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.98	1.52	3.03	4.08	3.25	4.36
	3.05	3.67	3.18	1.74	1.95	2.27
STD. DEVIATIONS	1.43	0.90	1.84	1.02	1.42	0.99
	1.57	2.52	2.68	0.36	0.77	1.06
RUNOFF						
TOTALS	0.077	0.015	0.720	0.615	0.055	0.420
	0.451	0.665	0.828	0.119	0.005	0.026
STD. DEVIATIONS	0.158	0.021	0.819	0.583	0.084	0.506
	0.445	1.236	1.578	0.117	0.012	0.039
EVAPOTRANSPIRATION						
TOTALS	0.529	0.942	1.751	3.486	3.522	4.595
	3.583	2.523	2.023	1.382	1.055	0.665
STD. DEVIATIONS	0.081	0.220	0.335	0.213	1.144	0.829
	1.454	0.893	1.198	0.463	0.362	0.160
PERCOLATION FROM LAYER 2						
TOTALS	0.1314	0.1750	0.4926	0.6028	0.5082	0.4152
	0.3529	0.2801	0.2217	0.1931	0.1611	0.1464
STD. DEVIATIONS	0.0423	0.0589	0.3927	0.4841	0.3744	0.2889
	0.2164	0.1532	0.1089	0.0861	0.0659	0.0551

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	34.08	(4.915)	680447.	100.00
RUNOFF	3.998	(2.152)	79811.	11.73

EVAPOTRANSPIRATION	26.055	(2.673)	520189.	76.45
PERCOLATION FROM LAYER 2	3.6804	(2.2194)	73478.	10.80
NGE IN WATER STORAGE	0.349	(2.662)	6969.	1.02

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.48	69478.2
RUNOFF	2.423	48375.1
PERCOLATION FROM LAYER 2	0.0484	965.3
SNOW WATER	3.37	67286.7

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4061
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1344

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	10.14	0.3381
2	11.11	0.1851
SNOW WATER	0.00	

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DEFAULT SOIL AND DESIGN DATA INPUT

Title: UNO-VEN CLOSURE PLAN
EXISTING CONDITIONS
LANDFARM AREA 2

Do you want the program to initialize the soil water? Y

Number of layers: 1

Layer data:

Layer 1
(a) thickness 6" inches
(b) layer type 1 (1 or 2)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number 5 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) N (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

Layer 2
(a) thickness ______ inches
(b) layer type ______ (1 to 4)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number ______ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ______ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

Layer 3
(a) thickness ______ inches
(b) layer type ______
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number ______ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ______ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

	Layer 4		Layer 5		Layer 6
(a)	______	(a)	______	(a)	______
(b)	______	(b)	______	(b)	______
(c)	______	(c)	______	(c)	______
(d)	______	(d)	______	(d)	______
(e)	______	(e)	______	(e)	______
(f)	______	(f)	______	(f)	______

Layer 7		Layer 8		Layer 9	
(a)	________	(a)	________	(a)	________
(b)	________	(b)	________	(b)	________
(c)	________	(c)	________	(c)	________
(d)	________	(d)	________	(d)	________
(e)	________	(e)	________	(e)	________
(f)	________	(f)	________	(f)	________

Layer 10		Layer 11		Layer 12	
(a)	________	(a)	________	(a)	________
(b)	________	(b)	________	(b)	________
(c)	________	(c)	________	(c)	________
(d)	________	(d)	________	(d)	________
(e)	________	(e)	________	(e)	________
(f)	________	(f)	________	(f)	________

If soil texture number of layer 1 is between 1 and 15, enter:
Type of vegetation: BARE GROUND (1 to 5)
SCS runoff curve number (optional): ________ (0 to 100)

If the soil texture number of layer 1 is between 16 and 20, enter:
SCS runoff curve number: ________ (0 to 100)

If landfill is open, enter potential runoff fraction: N (0 to 1)

Surface area: 182957 square feet

Slope of top liner/drain system: ________ percent
Distance from crest to drain in top liner/drain system: ________ feet

Slope of second liner/drain system: ________ percent
Distance from crest to drain in second liner/drain system: ________ feet

Slope of third liner/drain system: ________ percent
Distance from crest to drain in third liner/drain system: ________ feet

Slope of fourth liner/drain system: ________ percent
Distance from crest to drain in fourth liner/drain system: ________ feet

Initial quantity of snow or ice water on surface (not asked if program is to initialize the soil water): ________ inches

* If soil texture number is 19:

(a) wilting point ________ vol/vol
(b) field capacity ________ vol/vol
(c) porosity ________ vol/vol
(d) saturated hydraulic conductivity ________ cm/sec

If soil texture number is 20:

(a) wilting point ________ vol/vol
(b) field capacity ________ vol/vol
(c) porosity ________ vol/vol
(d) saturated hydraulic conductivity ________ cm/sec

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UNO-VEN CLOSURE PLAN
EXISTING CONDITIONS
LANDFARM AREA 2

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BARE GROUND

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	60.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	83.31
TOTAL AREA OF COVER	=	182952. SQ FT
EVAPORATIVE ZONE DEPTH	=	8.00 INCHES
UPPER LIMIT VEG. STORAGE	=	3.6560 INCHES
INITIAL VEG. STORAGE	=	1.3966 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	7.8540 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND

SOLAR RADIATION FOR CHICAGO ILLINOIS

MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 128
END OF GROWING SEASON (JULIAN DATE) = 282

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.40	26.00	36.00	48.80	59.10	68.60
73.00	71.90	64.70	53.50	39.80	27.70

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.35	538946.	100.00
RUNOFF	0.170	2598.	0.48
EVAPOTRANSPIRATION	24.465	372992.	69.21
PERCOLATION FROM LAYER 1	10.7073	163243.	30.29
CHANGE IN WATER STORAGE	0.007	113.	0.02
SOIL WATER AT START OF YEAR	12.87	196237.	
SOIL WATER AT END OF YEAR	12.88	196351.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.62	604046.	100.00
RUNOFF	1.953	29768.	4.93
EVAPOTRANSPIRATION	23.007	350772.	58.07
PERCOLATION FROM LAYER 1	12.3977	189016.	31.29

PRECIPITATION

TOTALS	1.98	1.52	3.03	4.08	3.25	4.36
	3.05	3.67	3.18	1.74	1.95	2.27
STD. DEVIATIONS	1.43	0.90	1.84	1.02	1.42	0.99
	1.57	2.52	2.68	0.36	0.77	1.06

RUNOFF

TOTALS	0.011	0.002	0.170	0.124	0.015	0.082
	0.091	0.256	0.261	0.001	0.000	0.002
STD. DEVIATIONS	0.024	0.005	0.228	0.192	0.033	0.116
	0.115	0.554	0.538	0.003	0.000	0.004

EVAPOTRANSPIRATION

TOTALS	0.553	0.969	1.661	2.924	2.961	3.278
	2.245	2.232	1.776	1.473	1.160	0.727
STD. DEVIATIONS	0.099	0.268	0.392	0.243	0.995	0.910
	0.520	0.744	0.981	0.418	0.453	0.200

PERCOLATION FROM LAYER 1

TOTALS	0.7518	0.8519	1.5956	0.9530	1.0335	0.8325
	0.9728	0.6816	1.1420	0.8524	0.4854	0.6706
STD. DEVIATIONS	0.4054	0.5206	1.3620	0.5074	0.6069	0.3348
	0.6045	0.2513	0.7603	0.5996	0.2042	0.4155

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	34.08	(4.915)	519614.	100.00
RUNOFF	1.017	(0.813)	15498.	2.98
EVAPOTRANSPIRATION	21.959	(2.261)	334783.	64.43
PERCOLATION FROM LAYER 1	10.8232	(1.9110)	165010.	31.76
CHANGE IN WATER STORAGE	0.284	(2.591)	4323.	0.83

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.48	53056.1
RUNOFF	1.180	17990.5
PERCOLATION FROM LAYER 1	0.1979	3017.6
SNOW WATER	3.28	50022.2

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3377

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0575

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	14.29	0.2382

SNOW WATER 0.00

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DEFAULT SOIL AND DESIGN DATA INPUT

Title: UNO-VEN CLOSURE PLAN
EXISTING CONDITIONS
LANDFARM AREA 3

Do you want the program to initialize the soil water? Y

Number of layers: 1

Layer data:

Layer 1
(a) thickness 100" inches
(b) layer type 1 (1 or 2)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number 5 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) N (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol (must be between wilting point and porosity)

Layer 2
(a) thickness ______ inches
(b) layer type ______ (1 to 4)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number ______ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ______ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol (must be between wilting point and porosity)

Layer 3
(a) thickness ______ inches
(b) layer type ______
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number ______ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ______ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol (must be between wilting point and porosity)

Layer 4	Layer 5	Layer 6
(a) ______	(a) ______	(a) ______
(b) ______	(b) ______	(b) ______
(c) ______	(c) ______	(c) ______
(d) ______	(d) ______	(d) ______
(e) ______	(e) ______	(e) ______
(f) ______	(f) ______	(f) ______

Layer 7		Layer 8		Layer 9	
(a)	______	(a)	______	(a)	______
(b)	______	(b)	______	(b)	______
(c)	______	(c)	______	(c)	______
(d)	______	(d)	______	(d)	______
(e)	______	(e)	______	(e)	______
(f)	______	(f)	______	(f)	______

Layer 10		Layer 11		Layer 12	
(a)	______	(a)	______	(a)	______
(b)	______	(b)	______	(b)	______
(c)	______	(c)	______	(c)	______
(d)	______	(d)	______	(d)	______
(e)	______	(e)	______	(e)	______
(f)	______	(f)	______	(f)	______

If soil texture number of layer 1 is between 1 and 15, enter:
Type of vegetation: BARE GROUND (1 to 5)
SCS runoff curve number (optional): ______ (0 to 100)

If the soil texture number of layer 1 is between 16 and 20, enter:
SCS runoff curve number: ______ (0 to 100)

If landfill is open, enter potential runoff fraction: N ______ (0 to 1)

Surface area: 52272 square feet

Slope of top liner/drain system: ______ percent
Distance from crest to drain in top liner/drain system: ______ feet

Slope of second liner/drain system: ______ percent
Distance from crest to drain in second liner/drain system: ______ feet

Slope of third liner/drain system: ______ percent
Distance from crest to drain in third liner/drain system: ______ feet

Slope of fourth liner/drain system: ______ percent
Distance from crest to drain in fourth liner/drain system: ______ feet

Initial quantity of snow or ice water on surface (not asked if program is to initialize the soil water): ______ inches

* If soil texture number is 19:

(a) wilting point ______ vol/vol
(b) field capacity ______ vol/vol
(c) porosity ______ vol/vol
(d) saturated hydraulic conductivity ______ cm/sec

If soil texture number is 20:

(a) wilting point ______ vol/vol
(b) field capacity ______ vol/vol
(c) porosity ______ vol/vol
(d) saturated hydraulic conductivity ______ cm/sec

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 UNO-VEN CLOSURE PLAN
 EXISTING CONDITIONS
 LANDFARM AREA 3

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                          BARE GROUND

                            LAYER  1
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                   VERTICAL PERCOLATION LAYER
   THICKNESS                       =     60.00 INCHES
   POROSITY                        =      0.4570 VOL/VOL
   FIELD CAPACITY                  =      0.1309 VOL/VOL
   WILTING POINT                   =      0.0580 VOL/VOL
   INITIAL SOIL WATER CONTENT      =      0.1309 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY =     0.001000000047 CM/SEC


                    GENERAL SIMULATION DATA
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   SCS RUNOFF CURVE NUMBER         =      83.31
   TOTAL AREA OF COVER             =   52272. SQ FT
   EVAPORATIVE ZONE DEPTH          =       8.00 INCHES
   UPPER LIMIT VEG. STORAGE        =       3.6560 INCHES
   INITIAL VEG. STORAGE            =       1.3966 INCHES
   INITIAL SNOW WATER CONTENT      =       0.0000 INCHES
   INITIAL TOTAL WATER STORAGE IN
     SOIL AND WASTE LAYERS         =       7.8540 INCHES

             SOIL WATER CONTENT INITIALIZED BY PROGRAM.


                      CLIMATOLOGICAL DATA
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   DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
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SOLAR RADIATION FOR CHICAGO ILLINOIS

MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 128
END OF GROWING SEASON (JULIAN DATE) = 282

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.40	26.00	36.00	48.80	59.10	68.60
73.00	71.90	64.70	53.50	39.80	27.70

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.35	153985.	100.00
RUNOFF	0.170	742.	0.48
EVAPOTRANSPIRATION	24.465	106569.	69.21
PERCOLATION FROM LAYER 1	10.7073	46641.	30.29
CHANGE IN WATER STORAGE	0.007	32.	0.02
SOIL WATER AT START OF YEAR	12.87	56068.	
SOIL WATER AT END OF YEAR	12.88	56100.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.62	172585.	100.00
NOFF	1.953	8505.	4.93
EVAPOTRANSPIRATION	23.007	100221.	58.07
PERCOLATION FROM LAYER 1	12.3977	54004.	31.29

CHANGE IN WATER STORAGE	2.262	9854.	5.71
SOIL WATER AT START OF YEAR	12.88	56100.	
SOIL WATER AT END OF YEAR	13.22	57604.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.92	8351.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.56	115695.	100.00
RUNOFF	0.815	3548.	3.07
EVAPOTRANSPIRATION	18.416	80218.	69.34
PERCOLATION FROM LAYER 1	11.3975	49648.	42.91
CHANGE IN WATER STORAGE	-4.068	-17718.	-15.31
SOIL WATER AT START OF YEAR	13.22	57604.	
SOIL WATER AT END OF YEAR	11.07	48236.	
SNOW WATER AT START OF YEAR	1.92	8351.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.50	141570.	100.00
RUNOFF	0.364	1587.	1.12
EVAPOTRANSPIRATION	22.462	97844.	69.11

PERCOLATION FROM LAYER 1	7.6022	33115.	23.39
CHANGE IN WATER STORAGE	2.072	9024.	6.37
SOIL WATER AT START OF YEAR	11.07	48236.	
SOIL WATER AT END OF YEAR	13.15	57260.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	36.38	158471.	100.00
RUNOFF	1.781	7758.	4.90
EVAPOTRANSPIRATION	21.444	93409.	58.94
PERCOLATION FROM LAYER 1	12.0112	52321.	33.02
CHANGE IN WATER STORAGE	1.144	4984.	3.14
SOIL WATER AT START OF YEAR	13.15	57260.	
SOIL WATER AT END OF YEAR	14.29	62243.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

PRECIPITATION

TOTALS	1.98	1.52	3.03	4.08	3.25	4.36
	3.05	3.67	3.18	1.74	1.95	2.27
STD. DEVIATIONS	1.43	0.90	1.84	1.02	1.42	0.99
	1.57	2.52	2.68	0.36	0.77	1.06

RUNOFF

TOTALS	0.011	0.002	0.170	0.124	0.015	0.082
	0.091	0.256	0.261	0.001	0.000	0.002
STD. DEVIATIONS	0.024	0.005	0.228	0.192	0.033	0.116
	0.115	0.554	0.538	0.003	0.000	0.004

EVAPOTRANSPIRATION

TOTALS	0.553	0.969	1.661	2.924	2.961	3.278
	2.245	2.232	1.776	1.473	1.160	0.727
STD. DEVIATIONS	0.099	0.268	0.392	0.243	0.995	0.910
	0.520	0.744	0.981	0.418	0.453	0.200

PERCOLATION FROM LAYER 1

TOTALS	0.7518	0.8519	1.5956	0.9530	1.0335	0.8325
	0.9728	0.6816	1.1420	0.8524	0.4854	0.6706
STD. DEVIATIONS	0.4054	0.5206	1.3620	0.5074	0.6069	0.3348
	0.6045	0.2513	0.7603	0.5996	0.2042	0.4155

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	34.08	(4.915)	148461.	100.00
RUNOFF	1.017	(0.813)	4428.	2.98
EVAPOTRANSPIRATION	21.959	(2.261)	95652.	64.43
PERCOLATION FROM LAYER 1	10.8232	(1.9110)	47146.	31.76
CHANGE IN WATER STORAGE	0.284	(2.591)	1235.	0.83

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.48	15158.9
RUNOFF	1.180	5140.1
PERCOLATION FROM LAYER 1	0.1979	862.2
SNOW WATER	3.28	14292.1

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3377

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0575

FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	14.29	0.2382

SNOW WATER 0.00

DEFAULT SOIL AND DESIGN DATA INPUT

Title: UNO-VEN CLOSURE PLAN
EXISTING CONDITION
LANDFARM AREA 4

Do you want the program to initialize the soil water? Y

Number of layers: 1

Layer data:

Layer 1
(a) thickness 60" inches
(b) layer type 1 (1 or 2)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number 5 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) N (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

Layer 2
(a) thickness ______ inches
(b) layer type ______ (1 to 4)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number ______ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ______ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

Layer 3
(a) thickness ______ inches
(b) layer type ______
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number ______ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ______ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

	Layer 4		Layer 5		Layer 6
(a)	______	(a)	______	(a)	______
(b)	______	(b)	______	(b)	______
(c)	______	(c)	______	(c)	______
(d)	______	(d)	______	(d)	______
(e)	______	(e)	______	(e)	______
(f)	______	(f)	______	(f)	______

Layer 7		Layer 8		Layer 9	
(a)	______	(a)	______	(a)	______
(b)	______	(b)	______	(b)	______
(c)	______	(c)	______	(c)	______
(d)	______	(d)	______	(d)	______
(e)	______	(e)	______	(e)	______
(f)	______	(f)	______	(f)	______

Layer 10		Layer 11		Layer 12	
(a)	______	(a)	______	(a)	______
(b)	______	(b)	______	(b)	______
(c)	______	(c)	______	(c)	______
(d)	______	(d)	______	(d)	______
(e)	______	(e)	______	(e)	______
(f)	______	(f)	______	(f)	______

If soil texture number of layer 1 is between 1 and 15, enter:
Type of vegetation: BARE GROUND (1 to 5)
SCS runoff curve number (optional): ______ (0 to 100)

If the soil texture number of layer 1 is between 16 and 20, enter:
SCS runoff curve number: ______ (0 to 100)

If landfill is open, enter potential runoff fraction: N (0 to 1)

Surface area: 113256 square feet

Slope of top liner/drain system: ______ percent
Distance from crest to drain in top liner/drain system: ______ feet

Slope of second liner/drain system: ______ percent
Distance from crest to drain in second liner/drain system: ______ feet

Slope of third liner/drain system: ______ percent
Distance from crest to drain in third liner/drain system: ______ feet

Slope of fourth liner/drain system: ______ percent
Distance from crest to drain in fourth liner/drain system: ______ feet

Initial quantity of snow or ice water on surface (not asked if program is to initialize the soil water): ______ inches

* If soil texture number is 19:

(a) wilting point ______ vol/vol
(b) field capacity ______ vol/vol
(c) porosity ______ vol/vol
(d) saturated hydraulic conductivity ______ cm/sec

If soil texture number is 20:

(a) wilting point ______ vol/vol
(b) field capacity ______ vol/vol
(c) porosity ______ vol/vol
(d) saturated hydraulic conductivity ______ cm/sec

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UNO-VEN CLOSURE PLAN
EXISTING CONDITIONS
LANDFARM AREA 4

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BARE GROUND

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	60.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	83.31
TOTAL AREA OF COVER	=	113256. SQ FT
EVAPORATIVE ZONE DEPTH	=	8.00 INCHES
UPPER LIMIT VEG. STORAGE	=	3.6560 INCHES
INITIAL VEG. STORAGE	=	1.3966 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	7.8540 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND

SOLAR RADIATION FOR CHICAGO ILLINOIS

MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 128
END OF GROWING SEASON (JULIAN DATE) = 282

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.40	26.00	36.00	48.80	59.10	68.60
73.00	71.90	64.70	53.50	39.80	27.70

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.35	333633.	100.00
RUNOFF	0.170	1608.	0.48
EVAPOTRANSPIRATION	24.465	230900.	69.21
PERCOLATION FROM LAYER 1	10.7073	101055.	30.29
CHANGE IN WATER STORAGE	0.007	70.	0.02
SOIL WATER AT START OF YEAR	12.87	121480.	
SOIL WATER AT END OF YEAR	12.88	121550.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.62	373934.	100.00
RUNOFF	1.953	18428.	4.93
EVAPOTRANSPIRATION	23.007	217145.	58.07
PERCOLATION FROM LAYER 1	12.3977	117010.	31.29

PERCOLATION FROM LAYER 1	7.6022	71750.	23.39
CHANGE IN WATER STORAGE	2.072	19551.	6.37
SOIL WATER AT START OF YEAR	11.07	104512.	
SOIL WATER AT END OF YEAR	13.15	124063.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	36.38	343354.	100.00
RUNOFF	1.781	16808.	4.90
EVAPOTRANSPIRATION	21.444	202387.	58.94
PERCOLATION FROM LAYER 1	12.0112	113362.	33.02
CHANGE IN WATER STORAGE	1.144	10798.	3.14
SOIL WATER AT START OF YEAR	13.15	124063.	
SOIL WATER AT END OF YEAR	14.29	134861.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

PRECIPITATION

TOTALS	1.98	1.52	3.03	4.08	3.25	4.36
	3.05	3.67	3.18	1.74	1.95	2.27
STD. DEVIATIONS	1.43	0.90	1.84	1.02	1.42	0.99
	1.57	2.52	2.68	0.36	0.77	1.06

RUNOFF

TOTALS	0.011	0.002	0.170	0.124	0.015	0.082
	0.091	0.256	0.261	0.001	0.000	0.002
STD. DEVIATIONS	0.024	0.005	0.228	0.192	0.033	0.116
	0.115	0.554	0.538	0.003	0.000	0.004

EVAPOTRANSPIRATION

TOTALS	0.553	0.969	1.661	2.924	2.961	3.278
	2.245	2.232	1.776	1.473	1.160	0.727
STD. DEVIATIONS	0.099	0.268	0.392	0.243	0.995	0.910
	0.520	0.744	0.981	0.418	0.453	0.200

PERCOLATION FROM LAYER 1

TOTALS	0.7518	0.8519	1.5956	0.9530	1.0335	0.8325
	0.9728	0.6816	1.1420	0.8524	0.4854	0.6706
STD. DEVIATIONS	0.4054	0.5206	1.3620	0.5074	0.6069	0.3348
	0.6045	0.2513	0.7603	0.5996	0.2042	0.4155

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	34.08	(4.915)	321666.	100.00
RUNOFF	1.017	(0.813)	9594.	2.98
EVAPOTRANSPIRATION	21.959	(2.261)	207246.	64.43
PERCOLATION FROM LAYER 1	10.8232	(1.9110)	102149.	31.76
CHANGE IN WATER STORAGE	0.284	(2.591)	2676.	0.83

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.48	32844.2
RUNOFF	1.180	11137.0
PERCOLATION FROM LAYER 1	0.1979	1868.1
SNOW WATER	3.28	30966.1

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3377

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0575

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	14.29	0.2382

SNOW WATER 0.00

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DEFAULT SOIL AND DESIGN DATA INPUT

Title: UNO-VEN CLOSURE PLAN
FINAL COVER SYSTEM DESIGN
LANDFARM AREA 4

Do you want the program to initialize the soil water? Y

Number of layers: 2

Layer data:

Layer 1
(a) thickness 30" inches
(b) layer type 1 (1 or 2)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number 9 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) Y (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

Layer 2
(a) thickness 60" inches
(b) layer type 1 (1 to 4)
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number 5 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) N (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

Layer 3
(a) thickness ______ inches
(b) layer type ______
(c) liner leakage fraction (only for layer type 4) ______ (0 to 1)
(d) soil texture number ______ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ______ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ______ vol/vol
(must be between wilting point and porosity)

	Layer 4		Layer 5		Layer 6
(a)		(a)		(a)	
(b)		(b)		(b)	
(c)		(c)		(c)	
(d)		(d)		(d)	
(e)		(e)		(e)	
(f)		(f)		(f)	

Layer 7		Layer 8		Layer 9	
(a)	____	(a)	____	(a)	____
(b)	____	(b)	____	(b)	____
(c)	____	(c)	____	(c)	____
(d)	____	(d)	____	(d)	____
(e)	____	(e)	____	(e)	____
(f)	____	(f)	____	(f)	____

Layer 10		Layer 11		Layer 12	
(a)	____	(a)	____	(a)	____
(b)	____	(b)	____	(b)	____
(c)	____	(c)	____	(c)	____
(d)	____	(d)	____	(d)	____
(e)	____	(e)	____	(e)	____
(f)	____	(f)	____	(f)	____

If soil texture number of layer 1 is between 1 and 15, enter:
Type of vegetation: FAIR (1 to 5)
SCS runoff curve number (optional): ____ (0 to 100)

If the soil texture number of layer 1 is between 16 and 20, enter:
SCS runoff curve number: ____ (0 to 100)

If landfill is open, enter potential runoff fraction: N (0 to 1)

Surface area: 113256 square feet

Slope of top liner/drain system: ____ percent
Distance from crest to drain in top liner/drain system: ____ feet

Slope of second liner/drain system: ____ percent
Distance from crest to drain in second liner/drain system: ____ feet

Slope of third liner/drain system: ____ percent
Distance from crest to drain in third liner/drain system: ____ feet

Slope of fourth liner/drain system: ____ percent
Distance from crest to drain in fourth liner/drain system: ____ feet

Initial quantity of snow or ice water on surface (not asked if program is to initialize the soil water): ____ inches

* If soil texture number is 19:

(a) wilting point ____ vol/vol
(b) field capacity ____ vol/vol
(c) porosity ____ vol/vol
(d) saturated hydraulic conductivity ____ cm/sec

If soil texture number is 20:

(a) wilting point ____ vol/vol
(b) field capacity ____ vol/vol
(c) porosity ____ vol/vol
(d) saturated hydraulic conductivity ____ cm/sec

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UNO-VEN CLOSURE PLAN
FINAL COVER SYSTEM DESIGN
LANDFARM AREA 4

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                                  FAIR GRASS


                                   LAYER  1
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                          VERTICAL PERCOLATION LAYER
   THICKNESS                          =     30.00 INCHES
   POROSITY                           =      0.4096 VOL/VOL
   FIELD CAPACITY                     =      0.2466 VOL/VOL
   WILTING POINT                      =      0.1353 VOL/VOL
   INITIAL SOIL WATER CONTENT         =      0.2466 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY   =      0.000028500002 CM/SEC



                                   LAYER  2
                                   --------

                          VERTICAL PERCOLATION LAYER
   THICKNESS                          =     60.00 INCHES
   POROSITY                           =      0.4570 VOL/VOL
   FIELD CAPACITY                     =      0.1309 VOL/VOL
   WILTING POINT                      =      0.0580 VOL/VOL
   INITIAL SOIL WATER CONTENT         =      0.1309 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY   =      0.001000000047 CM/SEC



                            GENERAL SIMULATION DATA
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   SCS RUNOFF CURVE NUMBER            =      81.48
   TOTAL AREA OF COVER                =  113256. SQ FT
   EVAPORATIVE ZONE DEPTH             =      20.00 INCHES
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UPPER LIMIT VEG. STORAGE	=	8.1920 INCHES
INITIAL VEG. STORAGE	=	5.7523 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	15.2520 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CHICAGO ILLINOIS

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 128
END OF GROWING SEASON (JULIAN DATE) = 282

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.40	26.00	36.00	48.80	59.10	68.60
73.00	71.90	64.70	53.50	39.80	27.70

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.35	333633.	100.00
RUNOFF	1.884	17784.	5.33
EVAPOTRANSPIRATION	28.298	267079.	80.05
PERCOLATION FROM LAYER 2	4.4419	41923.	12.57
CHANGE IN WATER STORAGE	0.725	6847.	2.05
SOIL WATER AT START OF YEAR	19.51	184097.	
SOIL WATER AT END OF YEAR	20.23	190944.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.62	373934.	100.00
RUNOFF	6.612	62402.	16.69
EVAPOTRANSPIRATION	27.159	256329.	68.55
PERCOLATION FROM LAYER 2	4.1749	39402.	10.54
CHANGE IN WATER STORAGE	1.674	15800.	4.23
SOIL WATER AT START OF YEAR	20.23	190944.	
SOIL WATER AT END OF YEAR	19.92	187974.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.99	18769.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.56	250673.	100.00
RUNOFF	2.621	24739.	9.87
EVAPOTRANSPIRATION	21.490	202822.	80.91
PERCOLATION FROM LAYER 2	6.7442	63652.	25.39
CHANGE IN WATER STORAGE	-4.295	-40540.	-16.17
SOIL WATER AT START OF YEAR	19.92	187974.	
SOIL WATER AT END OF YEAR	17.61	166204.	
SNOW WATER AT START OF YEAR	1.99	18769.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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DEFAULT SOIL AND DESIGN DATA INPUT

Title: UNO-VEN CLOSURE PLAN
FINAL COVER SYSTEM DESIGN
LANDFARM AREA 3

Do you want the program to initialize the soil water? Y

Number of layers: 2

Layer data:

Layer 1
(a) thickness 30" inches
(b) layer type ____ (1 or 2)
(c) liner leakage fraction (only for layer type 4) ____ (0 to 1)
(d) soil texture number 9 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) Y (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ____ vol/vol
(must be between wilting point and porosity)

Layer 2
(a) thickness 60" inches
(b) layer type 1 (1 to 4)
(c) liner leakage fraction (only for layer type 4) ____ (0 to 1)
(d) soil texture number 5 (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) N (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ____ vol/vol
(must be between wilting point and porosity)

Layer 3
(a) thickness ____ inches
(b) layer type ____
(c) liner leakage fraction (only for layer type 4) ____ (0 to 1)
(d) soil texture number ____ (1 to 20)*
(e) compacted? (only for soil textures 1 to 15) ____ (Yes or No)
(f) initial soil water content (not asked if program is to initialize the soil water or if layer type is 3 or 4) ____ vol/vol
(must be between wilting point and porosity)

	Layer 4		Layer 5		Layer 6
(a)	____	(a)	____	(a)	____
(b)	____	(b)	____	(b)	____
(c)	____	(c)	____	(c)	____
(d)	____	(d)	____	(d)	____
(e)	____	(e)	____	(e)	____
(f)	____	(f)	____	(f)	____

Layer 7		Layer 8		Layer 9	
(a)	______	(a)	______	(a)	______
(b)	______	(b)	______	(b)	______
(c)	______	(c)	______	(c)	______
(d)	______	(d)	______	(d)	______
(e)	______	(e)	______	(e)	______
(f)	______	(f)	______	(f)	______

Layer 10		Layer 11		Layer 12	
(a)	______	(a)	______	(a)	______
(b)	______	(b)	______	(b)	______
(c)	______	(c)	______	(c)	______
(d)	______	(d)	______	(d)	______
(e)	______	(e)	______	(e)	______
(f)	______	(f)	______	(f)	______

If soil texture number of layer 1 is between 1 and 15, enter:
Type of vegetation: FAIR ______ (1 to 5)
SCS runoff curve number (optional): ______ (0 to 100)

If the soil texture number of layer 1 is between 16 and 20, enter:
SCS runoff curve number: ______ (0 to 100)

If landfill is open, enter potential runoff fraction: N ______ (0 to 1)

Surface area: 32202 ______ square feet

Slope of top liner/drain system: ______ percent
Distance from crest to drain in top liner/drain system: ______ feet

Slope of second liner/drain system: ______ percent
Distance from crest to drain in second liner/drain system: ______ feet

Slope of third liner/drain system: ______ percent
Distance from crest to drain in third liner/drain system: ______ feet

Slope of fourth liner/drain system: ______ percent
Distance from crest to drain in fourth liner/drain system: ______ feet

Initial quantity of snow or ice water on surface (not asked if program is to initialize the soil water): ______ inches

* If soil texture number is 19:

(a) wilting point ______ vol/vol
(b) field capacity ______ vol/vol
(c) porosity ______ vol/vol
(d) saturated hydraulic conductivity ______ cm/sec

If soil texture number is 20:

(a) wilting point ______ vol/vol
(b) field capacity ______ vol/vol
(c) porosity ______ vol/vol
(d) saturated hydraulic conductivity ______ cm/sec

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UNO-VEN CLOSURE PLAN
FINAL COVER SYSTEM DESIGN
LANDFARM AREA 3

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	30.00 INCHES
POROSITY	=	0.4096 VOL/VOL
FIELD CAPACITY	=	0.2466 VOL/VOL
WILTING POINT	=	0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2466 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000028500002 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	60.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	81.48
TOTAL AREA OF COVER	=	52272. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES

UPPER LIMIT VEG. STORAGE = 8.1920 INCHES
INITIAL VEG. STORAGE = 5.7523 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 15.2520 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CHICAGO ILLINOIS

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 128
END OF GROWING SEASON (JULIAN DATE) = 282

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
21.40	26.00	36.00	48.80	59.10	68.60
73.00	71.90	64.70	53.50	39.80	27.70

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.35	153985.	100.00
RUNOFF	1.884	8208.	5.33
EVAPOTRANSPIRATION	28.298	123267.	80.05
PERCOLATION FROM LAYER 2	4.4419	19349.	12.57
CHANGE IN WATER STORAGE	0.725	3160.	2.05
SOIL WATER AT START OF YEAR	19.51	84968.	
SOIL WATER AT END OF YEAR	20.23	88128.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.62	172585.	100.00
RUNOFF	6.612	28801.	16.69
EVAPOTRANSPIRATION	27.159	118306.	68.55
PERCOLATION FROM LAYER 2	4.1749	18186.	10.54
CHANGE IN WATER STORAGE	1.674	7292.	4.23
SOIL WATER AT START OF YEAR	20.23	88128.	
SOIL WATER AT END OF YEAR	19.92	86757.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.99	8663.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.56	115695.	100.00
RUNOFF	2.621	11418.	9.87
EVAPOTRANSPIRATION	21.490	93610.	80.91
PERCOLATION FROM LAYER 2	6.7442	29378.	25.39
CHANGE IN WATER STORAGE	-4.295	-18711.	-16.17
SOIL WATER AT START OF YEAR	19.92	86757.	
SOIL WATER AT END OF YEAR	17.61	76710.	
SNOW WATER AT START OF YEAR	1.99	8663.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.50	141570.	100.00
RUNOFF	2.863	12470.	8.81
EVAPOTRANSPIRATION	26.052	113482.	80.16
PERCOLATION FROM LAYER 2	1.2377	5391.	3.81
CHANGE IN WATER STORAGE	2.348	10226.	7.22
SOIL WATER AT START OF YEAR	17.61	76710.	
SOIL WATER AT END OF YEAR	19.96	86936.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	36.38	158471.	100.00
RUNOFF	6.008	26169.	16.51
EVAPOTRANSPIRATION	27.276	118813.	74.97
PERCOLATION FROM LAYER 2	1.8031	7854.	4.96
CHANGE IN WATER STORAGE	1.294	5635.	3.56
SOIL WATER AT START OF YEAR	19.96	86936.	
SOIL WATER AT END OF YEAR	21.25	92571.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.98	1.52	3.03	4.08	3.25	4.36
	3.05	3.67	3.18	1.74	1.95	2.27
STD. DEVIATIONS	1.43	0.90	1.84	1.02	1.42	0.99
	1.57	2.52	2.68	0.36	0.77	1.06
RUNOFF						
TOTALS	0.077	0.015	0.720	0.615	0.055	0.420
	0.451	0.665	0.828	0.119	0.005	0.026
STD. DEVIATIONS	0.158	0.021	0.819	0.583	0.084	0.506
	0.445	1.236	1.578	0.117	0.012	0.039
EVAPOTRANSPIRATION						
TOTALS	0.529	0.942	1.751	3.486	3.522	4.595
	3.583	2.523	2.023	1.382	1.055	0.665
STD. DEVIATIONS	0.081	0.220	0.335	0.213	1.144	0.829
	1.454	0.893	1.198	0.463	0.362	0.160
PERCOLATION FROM LAYER 2						
TOTALS	0.1314	0.1750	0.4926	0.6028	0.5082	0.4152
	0.3529	0.2801	0.2217	0.1931	0.1611	0.1464
STD. DEVIATIONS	0.0423	0.0589	0.3927	0.4841	0.3744	0.2889
	0.2164	0.1532	0.1089	0.0861	0.0659	0.0551

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	34.08	(4.915)	148461.	100.00
RUNOFF	3.998	(2.152)	17413.	11.73

EVAPOTRANSPIRATION	26.055	(2.673)	113496.	76.45
PERCOLATION FROM LAYER 2	3.6804	(2.2194)	16032.	10.80
CHANGE IN WATER STORAGE	0.349	(2.662)	1521.	1.02

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.48	15158.9
RUNOFF	2.423	10554.6
PERCOLATION FROM LAYER 2	0.0484	210.6
SNOW WATER	3.37	14680.7

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4061

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1344

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	10.14	0.3381
2	11.11	0.1851
SNOW WATER	0.00	

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.50	306735.	100.00
RUNOFF	2.863	27019.	8.81
EVAPOTRANSPIRATION	26.052	245878.	80.16
PERCOLATION FROM LAYER 2	1.2377	11682.	3.81
CHANGE IN WATER STORAGE	2.348	22157.	7.22
SOIL WATER AT START OF YEAR	17.61	166204.	
SOIL WATER AT END OF YEAR	19.96	188361.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	36.38	343354.	100.00
RUNOFF	6.008	56699.	16.51
EVAPOTRANSPIRATION	27.276	257429.	74.97
PERCOLATION FROM LAYER 2	1.8031	17018.	4.96
CHANGE IN WATER STORAGE	1.294	12209.	3.56
SOIL WATER AT START OF YEAR	19.96	188361.	
SOIL WATER AT END OF YEAR	21.25	200570.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.98	1.52	3.03	4.08	3.25	4.36
	3.05	3.67	3.18	1.74	1.95	2.27
STD. DEVIATIONS	1.43	0.90	1.84	1.02	1.42	0.99
	1.57	2.52	2.68	0.36	0.77	1.06
RUNOFF						
TOTALS	0.077	0.015	0.720	0.615	0.055	0.420
	0.451	0.665	0.828	0.119	0.005	0.026
STD. DEVIATIONS	0.158	0.021	0.819	0.583	0.084	0.506
	0.445	1.236	1.578	0.117	0.012	0.039
EVAPOTRANSPIRATION						
TOTALS	0.529	0.942	1.751	3.486	3.522	4.595
	3.583	2.523	2.023	1.382	1.055	0.665
STD. DEVIATIONS	0.081	0.220	0.335	0.213	1.144	0.829
	1.454	0.893	1.198	0.463	0.362	0.160
PERCOLATION FROM LAYER 2						
TOTALS	0.1314	0.1750	0.4926	0.6028	0.5082	0.4152
	0.3529	0.2801	0.2217	0.1931	0.1611	0.1464
STD. DEVIATIONS	0.0423	0.0589	0.3927	0.4841	0.3744	0.2889
	0.2164	0.1532	0.1089	0.0861	0.0659	0.0551

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	34.08	(4.915)	321666.	100.00
RUNOFF	3.998	(2.152)	37729.	11.73

CHANGE IN WATER STORAGE	2.262	34491.	5.71
SOIL WATER AT START OF YEAR	12.88	196351.	
SOIL WATER AT END OF YEAR	13.22	201613.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.92	29228.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.56	404934.	100.00
RUNOFF	0.815	12419.	3.07
EVAPOTRANSPIRATION	18.416	280763.	69.34
PERCOLATION FROM LAYER 1	11.3975	173766.	42.91
CHANGE IN WATER STORAGE	-4.068	-62015.	-15.31
SOIL WATER AT START OF YEAR	13.22	201613.	
SOIL WATER AT END OF YEAR	11.07	168827.	
SNOW WATER AT START OF YEAR	1.92	29228.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT
ECIPITATION	32.50	495495.	100.00
RUNOFF	0.364	5556.	1.12
EVAPOTRANSPIRATION	22.462	342452.	69.11

EVAPOTRANSPIRATION	26.055	(2.673)	245907.	76.45
PERCOLATION FROM LAYER 2	3.6804	(2.2194)	34735.	10.80
CHANGE IN WATER STORAGE	0.349	(2.662)	3295.	1.02

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.48	32844.2
RUNOFF	2.423	22868.3
PERCOLATION FROM LAYER 2	0.0484	456.3
SNOW WATER	3.37	31808.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4061

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1344

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	10.14	0.3381
2	11.11	0.1851
SNOW WATER	0.00	

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APPENDIX C

DESIGN CALCULATION: SOIL EROSION

GERAGHTY & MILLER, INC. Environmental Services	SUBJECT: SOIL EROSION	BY: RAI DATE: 8/23/93
	PROJECT: UNO-VEN CLOSURE PLAN	CHKD: DATE:
	CLIENT/PROJECT NO: CI0264.002	REV: DATE:

PAGE

SHEET 1/8

Erosion & Sediment Control Handbook; Goldman, et.al.; 1986.

Estimate of erosion losses

Universal Soil Loss Equation - $A = RKLSCP$

A = soil loss
R = rainfall erosion index
K = soil erodibility factor
LS = slope length and steepness factor
C = vegetation cover factor
P = erosion control practice factor

A. Landform Area 1

$R = 160$ as per Fig 5.2; Sheet 3/8
K - assume a soil that is silty clay loam
$K = 0.39$ as per Fig 5.6; Sheet 4/8
LS = 0.87 for 4.0% and $L = 700'$
0.77 for 8.0% and $L = 60'$
2.98 for 33% and $L = 10'$
Table 5.5; Sheets 5/8 & 6/8
$C = 0.5$ as per Table 5.6; Sheet 7/8
$P = 0.9$ as per Table 5.7; Sheet 8/8

$$A = RKLS_{4\%}CP + RKLS_{8\%}CP + RKLS_{33\%}CP$$

$$A = [(160)(0.39)(0.87)(0.5)(0.9)] + [(160)(0.39)(0.77)(0.5)(0.9)] + [(160)(0.39)(2.98)(0.5)(0.9)]$$

A = 129.7 tons/acre/year

B. Landform Area 2

$R = 160$
$K = 0.39$
LS = 0.62 for 4.0% and $L = 300'$
5.17 for 33% and $L = 30'$
$C = 0.5$
$P = 0.9$

$$A = RKLS_{4\%}CP + RKLS_{33\%}CP$$

$$A = [(160)(0.39)(0.62)(0.5)(0.9)] + [(160)(0.39)(5.17)(0.5)(0.9)]$$

A = 162.6 tons/acre/year

C. Landform Area 3

$R = 160$
$K = 0.39$
LS = 0.92 for 6% and $L = 150'$
0.30 for 4% and $L = 30'$
7.30 for 33% and $L = 60'$
$C = 0.5$
$P = 0.9$

Form 30 6-89 Southprint 89-1294

5/8

TABLE 5.5 LS Values* (10)

Slope ratio	Slope gradient s, %	LS values for following slope lengths l, ft (m): 10 (3.0)	20 (6.1)	30 (9.1)	40 (12.2)	50 (15.2)	60 (18.3)	70 (21.3)	80 (24.4)	90 (27.4)	100 (30.5)
	0.5	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.09	0.09	0.10
100:1	1	0.08	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.12	0.12
	2	0.10	0.12	0.14	0.15	0.16	0.17	0.18	0.19	0.19	0.20
	3	0.14	0.18	0.20	0.22	0.23	0.25	0.26	0.27	0.28	0.29
	4	0.16	0.21	0.25	0.28	0.30	0.33	0.35	0.37	0.38	0.40
20:1	5	0.17	0.24	0.29	0.34	0.38	0.41	0.45	0.48	0.51	0.53
	6	0.21	0.30	0.37	0.43	0.48	0.52	0.56	0.60	0.64	0.67
	7	0.26	0.37	0.45	0.52	0.58	0.64	0.69	0.74	0.78	0.82
12½:1	8	0.31	0.44	0.54	0.63	0.70	0.77	0.83	0.89	0.94	0.99
	9	0.37	0.52	0.64	0.74	0.83	0.91	0.98	1.05	1.11	1.17
10:1	10	0.43	0.61	0.75	0.87	0.97	1.06	1.15	1.22	1.30	1.37
	11	0.50	0.71	0.86	1.00	1.12	1.22	1.32	1.41	1.50	1.58
8:1	12.5	0.61	0.86	1.05	1.22	1.36	1.49	1.61	1.72	1.82	1.92
	15	0.81	1.14	1.40	1.62	1.81	1.98	2.14	2.29	2.43	2.56
6:1	16.7	0.96	1.36	1.67	1.92	2.15	2.36	2.54	2.72	2.88	3.04
5:1	20	1.29	1.82	2.23	2.58	2.88	3.16	3.41	3.65	3.87	4.08
4½:1	22	1.51	2.13	2.61	3.02	3.37	3.69	3.99	4.27	4.53	4.77
4:1	25	1.86	2.63	3.23	3.73	4.16	4.56	4.93	5.27	5.59	5.89
	30	2.51	3.56	4.36	5.03	5.62	6.16	6.65	7.11	7.54	7.95
3:1	33.3	2.98	4.22	5.17	5.96	6.67	7.30	7.89	8.43	8.95	9.43
	35	3.23	4.57	5.60	6.46	7.23	7.92	8.55	9.14	9.70	10.22
2½:1	40	4.00	5.66	6.93	8.00	8.95	9.80	10.59	11.32	12.00	12.65
	45	4.81	6.80	8.33	9.61	10.75	11.77	12.72	13.60	14.42	15.20
2:1	50	5.64	7.97	9.76	11.27	12.60	13.81	14.91	15.94	16.91	17.82
	55	6.48	9.16	11.22	12.96	14.48	15.87	17.14	18.32	19.43	20.48
1¾:1	57	6.82	9.64	11.80	13.63	15.24	16.69	18.03	19.28	20.45	21.55
	60	7.32	10.35	12.68	14.64	16.37	17.93	19.37	20.71	21.96	23.15
1½:1	66.7	8.44	11.93	14.61	16.88	18.87	20.67	22.32	23.87	25.31	26.68
	70	8.98	12.70	15.55	17.96	20.08	21.99	23.75	25.39	26.93	28.39
	75	9.78	13.83	16.94	19.56	21.87	23.95	25.87	27.66	29.34	30.92
1¼:1	80	10.55	14.93	18.28	21.11	23.60	25.85	27.93	29.85	31.66	33.38
	85	11.30	15.98	19.58	22.61	25.27	27.69	29.90	31.97	33.91	35.74
	90	12.02	17.00	20.82	24.04	26.88	29.44	31.80	34.00	36.06	38.01
	95	12.71	17.97	22.01	25.41	28.41	31.12	33.62	35.94	38.12	40.18
1:1	100	13.36	18.89	23.14	26.72	29.87	32.72	35.34	37.78	40.08	42.24

*Calculated from

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right)\left(\frac{l}{72.5}\right)^m$$

LS = topographic factor
l = slope length, ft (m × 0.3048)
s = slope steepness,
m = exponent dependent upon slope steepness (0.2 for slopes < 1%, 0.3 for slopes 1 to 3%, 0.4 for slopes 3.5 to 4.5%, and 0.5 for slopes > 5%)

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LS values for following slope lengths l, ft (m)												
150 (46)	200 (61)	250 (76)	300 (91)	350 (107)	400 (122)	450 (137)	500 (152)	600 (183)	700 (213)	800 (244)	900 (274)	1000 (305)
0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.15	0.15
0.14	0.14	0.15	0.16	0.16	0.16	0.17	0.17	0.18	0.18	0.19	0.19	0.20
0.23	0.25	0.26	0.28	0.29	0.30	0.32	0.33	0.34	0.36	0.37	0.39	0.40
0.32	0.35	0.38	0.40	0.42	0.43	0.45	0.46	0.49	0.51	0.54	0.55	0.57
0.47	0.53	0.58	0.62	0.66	0.70	0.73	0.76	0.82	0.87	0.92	0.96	1.00
0.66	0.76	0.85	0.93	1.00	1.07	1.13	1.20	1.31	1.42	1.51	1.60	1.69
0.82	0.95	1.06	1.16	1.26	1.34	1.43	1.50	1.65	1.78	1.90	2.02	2.13
1.01	1.17	1.30	1.43	1.54	1.65	1.75	1.84	2.02	2.18	2.33	2.47	2.61
1.21	1.40	1.57	1.72	1.85	1.98	2.10	2.22	2.43	2.62	2.80	2.97	3.13
1.44	1.66	1.85	2.03	2.19	2.35	2.49	2.62	2.87	3.10	3.32	3.52	3.71
1.68	1.94	2.16	2.37	2.56	2.74	2.90	3.06	3.35	3.62	3.87	4.11	4.33
1.93	2.23	2.50	2.74	2.95	3.16	3.35	3.53	3.87	4.18	4.47	4.74	4.99
2.35	2.72	3.04	3.33	3.59	3.84	4.08	4.30	4.71	5.08	5.43	5.76	6.08
3.13	3.62	4.05	4.43	4.79	5.12	5.43	5.72	6.27	6.77	7.24	7.68	8.09
3.72	4.30	4.81	5.27	5.69	6.08	6.45	6.80	7.45	8.04	8.60	9.12	9.62
5.00	5.77	6.45	7.06	7.63	8.16	8.65	9.12	9.99	10.79	11.54	12.24	12.90
5.84	6.75	7.54	8.26	8.92	9.54	10.12	10.67	11.68	12.62	13.49	14.31	15.08
7.21	8.33	9.31	10.20	11.02	11.78	12.49	13.17	14.43	15.58	16.66	17.67	18.63
9.74	11.25	12.57	13.77	14.88	15.91	16.87	17.78	19.48	21.04	22.49	23.86	25.15
11.55	13.34	14.91	16.33	17.64	18.86	20.00	21.09	23.10	24.95	26.67	28.29	29.82
12.52	14.46	16.16	17.70	19.12	20.44	21.68	22.86	25.04	27.04	28.91	30.67	32.32
15.50	17.89	20.01	21.91	23.67	25.30	26.84	28.29	30.99	33.48	35.79	37.96	40.01
18.62	21.50	24.03	26.33	28.44	30.40	32.24	33.99	37.23	40.22	42.99	45.60	48.07
21.83	25.21	28.18	30.87	33.34	35.65	37.81	39.85	43.66	47.16	50.41	53.47	56.36
25.09	28.97	32.39	35.48	38.32	40.97	43.45	45.80	50.18	54.20	57.94	61.45	64.78
26.40	30.48	34.08	37.33	40.32	43.10	45.72	48.19	52.79	57.02	60.96	64.66	68.15
28.35	32.74	36.60	40.10	43.31	46.30	49.11	51.77	56.71	61.25	65.48	69.45	73.21
32.68	37.74	42.19	46.22	49.92	53.37	56.60	59.66	65.36	70.60	75.47	80.05	84.38
34.77	40.15	44.89	49.17	53.11	56.78	60.23	63.48	69.54	75.12	80.30	85.17	89.78
37.87	43.73	48.89	53.56	57.85	61.85	65.60	69.15	75.75	81.82	87.46	92.77	97.79
40.88	47.20	52.77	57.81	62.44	66.75	70.80	74.63	81.76	88.31	94.41	100.13	105.55
43.78	50.55	56.51	61.91	66.87	71.48	75.82	79.92	87.55	94.57	101.09	107.23	113.03
46.55	53.76	60.10	65.84	71.11	76.02	80.63	84.99	93.11	100.57	107.51	114.03	120.20
49.21	56.82	63.53	69.59	75.17	80.36	85.23	89.84	98.42	106.30	113.64	120.54	127.06
51.74	59.74	66.79	73.17	79.03	84.49	89.61	94.46	103.48	111.77	119.48	126.73	133.59

7|3

TABLE 5.6 *C* Values for Soil Loss Equation*

Type of cover	*C* factor	Soil loss reduction, %
None	1.0	0
Native vegetation (undisturbed)	0.01	99
Temporary seedings:		
90% cover, annual grasses, no mulch	0.1	90
Wood fiber mulch, ¾ ton/acre (1.7 t/ha), with seed†	0.5	50
Excelsior mat, jute†	0.3	70
Straw mulch†		
1.5 tons/acre (3.4 t/ha), tacked down	0.2	80
4 tons/acre (9.0 t/ha), tacked down	0.05	95

*Adapted from Refs. 11, 15, and 20

†For slopes up to 2:1.

if a complete cover of newly seeded annual grasses is well established before the onset of rains.

In many areas, seed and wood fiber mulch are applied hydraulically shortly before the rainy season. The early rains cause the seeds to germinate, but a complete grass cover is not established until at least 4 weeks later. During the germination and early growth period, the wood fiber mulch provides only marginal protection. A *C* value of 0.5 is an appropriate average representing little protection initially and more thorough protection when the grass is well established.

On bare soils mulch can provide immediate reduction in soil loss, and it performs better than temporary seedings in some cases. Straw mulch is more effective than wood fiber mulch; it reduces loss about 80 percent (*C* value, 0.2) when it is applied at the rate of 3000 lb/acre (3.4 t/ha) and tacked down. Additional reduction is obtained with 8000 lb/acre (90 t/ha) of straw, but this rate may not be cost-effective.

Wood fiber mulch alone (without seed) provides very little soil loss reduction; it primarily helps seeds to become established so that the new grass can provide the erosion control. Other products, such as jute, excelsior, and paper matting, provide an intermediate level of protection; the *C* value equals approximately 0.3. Test results of various mulch treatments are presented in Chap. 6.

5.2f Erosion Control Practice Factor *P*

The erosion control practice factor *P* is defined as the ratio of soil loss with a given surface condition to soil loss with up-and-down-hill plowing. Practices that reduce the velocity of runoff and the tendency of runoff to flow directly downslope reduce the *P* factor. In agricultural uses of the USLE, *P* is used to describe plowing and tillage practices. In construction site applications, *P* reflects the roughening of the soil surface by tractor treads or by rough grading, raking, or disking.

8|8

TABLE 5.7 *P* Factors for Construction Sites (Adapted from Ref. 15)

Surface condition	*P* value
Compacted and smooth	1.3
Trackwalked along contour*	1.2
Trackwalked up and down slope†	0.9
Punched straw	0.9
Rough, irregular cut	0.9
Loose to 12-in (30-cm) depth	0.8

*Tread marks oriented up and down slope.

†Tread marks oriented parallel to contours, as in Figs. 6.9 and 6.10.

P values appropriate for construction sites are listed in Table 5.7.

- A surface that is compacted and smoothed by grading equipment is highly susceptible to sheet runoff and is assigned a *P* value of 1.3.
- Trackwalking is given a value of 1.2 if the vehicle traverses along the contour. The *P* value is relatively high because the depressions left by cross-slope tracking resemble up-and-down furrows and worsen runoff conditions.
- Trackwalking up and down slope reduces *P* to 0.9. The tread marks act as slope benches; they reduce runoff velocity and trap soil particles (see Fig. 6.10).
- Punched straw is assigned a *P* value of 0.9 because the action of punching the straw into the soil roughens the surface and creates a trackwalking effect.
- When the soil surface is disked or otherwise loosened to a depth of 1 ft, a slightly lower *P* value of 0.8 may be used. This condition is unlikely to occur on a construction site because compaction, not loosening, is required when fill slopes are constructed.

Clearly, changing the surface condition does not provide much direct reduction in soil loss; all the *P* values are close to 1.0. However, roughening the soil surface is essential before seeding because it greatly increases plant establishment (see Chap. 6) and thus also reduces the *C* factor. Vegetation, mulch, slope length, and gradient have far more significant effects on the erosion process and provide greater opportunities to reduce soil loss.

5.2g Combined Effects of LS, *C*, and *P*

Of the five factors in the USLE, the *R*, LS, and *C* factors have the widest range. Although *R* for a site is constant and *K* is essentially a constant, slope length and gradient, cover, and, to a limited extent, surface condition can be manipulated. Slope length and vegetative cover are the most effective and easily implemented measures.

Table 5.8 compares the effect on the soil loss estimates of varying LS, *C*, and *P*. For example, a building pad with a 1 percent slope, smooth surface, and no cover has a fractional soil loss potential. A 2:1 slope, common between terraced

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

LANDFARM AREA I:DIVERSION CHANNEL NO. 1

by

Name: R. ISAAC

Company Name: GERAGHTY & MILLER, INC.
File Name: C:\SEDCAD3\LFDIV1

Date: 08-25-1993

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: GERAGHTY & MILLER, INC.

Filename: C:\SEDCAD3\LFDIV1 User: R. ISAAC

Date: 08-25-1993 Time: 10:42:09

LANDFARM AREA I:DIVERSION CHANNEL NO. 1

Storm: 5.80 inches, 100 year-24 hour, SCS Type II

Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	1.26	83	M	0.217	0.143	0.213	0.0	0.41	3.87
111	2	1.60	83	M	0.236	0.236	0.158	0.0	0.52	4.81
			Type: Null		Label: LFDIV1					
111	Structure	2.86							0.94	
111	Total IN/OUT	2.86							0.94	7.61

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: GERAGHTY & MILLER, INC.
Filename: C:\SEDCAD3\LFDIV1 User: R. ISAAC
Date: 08-25-1993 Time: 10:42:09
LANDFARM AREA I:DIVERSION CHANNEL NO. 1
Storm: 5.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	1	200.00	10.00	0.80	0.07			
				-b	6	400.00	1.00	1.50	0.07			
				-c	6	400.00	1.00	1.50	0.07	0.217		
1	1	1	1	-1	1	201.00	10.00	0.80	0.07			
				-2	6	400.02	1.00	1.50	0.07		0.143	0.213
1	1	1	2	-a	1	450.00	6.67	0.65	0.19			
				-b	6	180.00	0.56	1.12	0.04	0.236		
1	1	1	2	-1	1	451.00	6.67	0.65	0.19			
				-2	6	180.00	0.56	1.12	0.04		0.236	0.158

SEDCAD+ VEGETATED CHANNEL DESIGN

LANDFARM AREA I:DIVERSION NO. 1

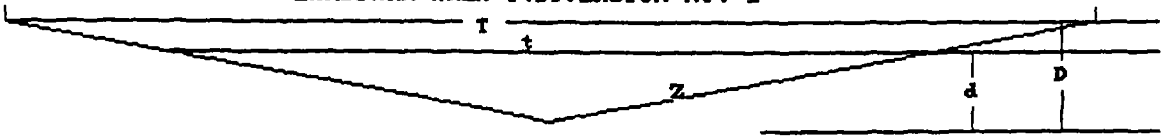
INPUT VALUES:

Shape	TRIANGULAR
Discharge	7.61 cfs
Slope	1.00 %
Sideslopes	3.00:1 (L) 3.00:1 (R)
Max. Velocity	5.000fps
Material	GRASS MIXTURE
Freeboard	Max(ft, %)

RESULTS:

	STABILITY CLASS D	CAPACITY CLASS B	w/ FREEBOARD
Actual Discharge	7.57	7.08 cfs	
Depth	1.20	1.89	1.89 ft
Top Width	7.22	11.32	11.32 ft
Velocity	1.74	0.66 fps	
Cross Sectional Area	4.34	10.67 sq ft	
Hydraulic Radius	0.57	0.89 ft	
Manning's n	0.059	0.209	
Froude Number	0.40	0.12	

SEDCAD+ CHANNEL DESIGN
LANDFARM AREA I:DIVERSION NO. 1



MATERIAL: GRASS MIXTURE
Limiting Variable: Velocity = 5.000 fps

				STABILITY CLASS D	CAPACITY CLASS B	w/ FREEBOARD (+ CLASS B)
Discharge	= 7.00 cfs	Depth (d)	=	1.20	1.89	1.89 ft
Side slopes (Z)	= 3.0:1(L) 3.0:1(R)	Top width (t)	=	7.22	11.32	11.32 ft
		Velocity	=	1.74	0.66 fps	
		Hydraulic Radius	=	0.57	0.89 ft	
Bed Slope	= 1.00 %	Manning's n	=	0.059	0.209	
		Froude number	=	0.40	0.12	

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

LANDFARM AREA III:DIVERSION CHANNEL NO. 1

by

Name: R. ISAAC

Company Name: GERAGHTY & MILLER, INC.
File Name: C:\SEDCAD3\LFDIV2

Date: 08-25-1993

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: GERAGHTY & MILLER, INC.
Filename: C:\SEDCAD3\LFDIV2 User: R. ISAAC
Date: 08-25-1993 Time: 11:23:44
LANDFARM AREA III:DIVERSION CHANNEL NO. 1
Storm: 5.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	7.47	83	M	0.119	0.119	0.310	0.0	2.45	28.31
111	2	1.52	83	M	0.070	0.070	0.293	0.0	0.50	5.76
	Type: Null Label: LFDIV3-1									
111	Structure	8.99							2.95	
111	Total IN/OUT	8.99							2.95	32.63

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: GERAGHTY & MILLER, INC.

Filename: C:\SEDCAD3\LFDIV2 User: R. ISAAC

Date: 08-25-1993 Time: 11:23:44

LANDFARM AREA III:DIVERSION CHANNEL NO. 1

Storm: 5.80 inches, 100 year-24 hour, SCS Type II

Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	5	800.00	7.50	2.74	0.08			
				-b	6	400.00	3.75	2.90	0.04	0.119		
1	1	1	1	-1	5	802.25	7.50	2.74	0.08			
				-2	6	400.28	3.75	2.90	0.04		0.119	0.310
1	1	1	2	-a	5	350.00	8.57	2.93	0.03			
				-b	6	200.00	1.00	1.50	0.04	0.070		
1	1	1	2	-1	5	351.28	8.57	2.93	0.03			
				-2	6	200.01	1.00	1.50	0.04		0.070	0.293

SEDCAD+ VEGETATED CHANNEL DESIGN

LANDFARM AREA III:DIVERSION NO. 1

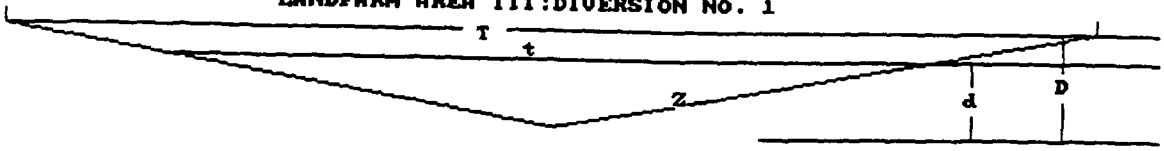
INPUT VALUES:

Shape	TRIANGULAR	
Discharge	32.63 cfs	
Slope	2.80 %	
Sideslopes	3.00:1 (L)	3.00:1 (R)
Max. Velocity	5.000fps	
Material	GRASS MIXTURE	
Freeboard	Max(ft, %)	

RESULTS:

	STABILITY CLASS D	CAPACITY CLASS B	w/ FREEBOARD
Actual Discharge	32.52	32.07 cfs	
Depth	1.47	1.97	1.97 ft
Top Width	8.84	11.80	11.80 ft
Velocity	4.99	2.76 fps	
Cross Sectional Area	6.52	11.61 sq ft	
Hydraulic Radius	0.70	0.93 ft	
Manning's n	0.039	0.086	
Froude Number	1.02	0.49	

SEDCAD+ CHANNEL DESIGN
LANDFARM AREA III:DIVERSION NO. 1



MATERIAL: GRASS MIXTURE
Limiting Variable: Velocity = 5.000 fps

Discharge = 32.07 cfs
Side slopes (Z) = 3.0:1(L) 3.0:1(R)
Bed Slope = 2.00 %

		STABILITY CLASS D	CAPACITY CLASS B	w/ FREEBOARD (+ CLASS B)
Depth (d)	=	1.47	1.97	1.97 ft
Top width (t)	=	8.84	11.80	11.80 ft
Velocity	=	4.99	2.76 fps	
Hydraulic Radius	=	0.70	0.93 ft	
Manning's n	=	0.039	0.086	
Froude number	=	1.02	0.49	

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

LANDFARM AREA IV:DIVERSION NO. 1

by

Name: R. ISAAC

Company Name: GERAGHTY & MILLER, INC.
File Name: C:\SEDCAD3\LF4DIV1

Date: 08-25-1993

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: GERAGHTY & MILLER, INC.
Filename: C:\SEDCAD3\LF4DIV1 User: R. ISAAC
Date: 08-25-1993 Time: 11:34:15
LANDFARM AREA IV:DIVERSION NO. 1
Storm: 5.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	3.09	83	M	0.268	0.000	0.000	0.0	1.01	8.90
		Type: Null			Label: LF4DIV1					
111	Structure	3.09							1.01	
111	Total IN/OUT	3.09							1.01	8.90

SEDCAD+ VEGETATED CHANNEL DESIGN

LANDFARM AREA IV:DIVERSION NO. 1

INPUT VALUES:

Shape	TRIANGULAR	
Discharge	8.90 cfs	
Slope	1.30 %	
Sideslopes	3.00:1 (L)	3.00:1 (R)
Max. Velocity	5.000fps	
Material	GRASS MIXTURE	
Freeboard	Max(ft, %)	

RESULTS:

	STABILITY CLASS D	CAPACITY CLASS B	W/ FREEBOARD
Actual Discharge	8.85	8.42 cfs	
Depth	1.19	1.81	1.81 ft
Top Width	7.12	10.84	10.84 ft
Velocity	2.09	0.86 fps	
Cross Sectional Area	4.23	9.78 sq ft	
Hydraulic Radius	0.56	0.86 ft	
Manning's n	0.055	0.178	
Froude Number	0.48	0.16	

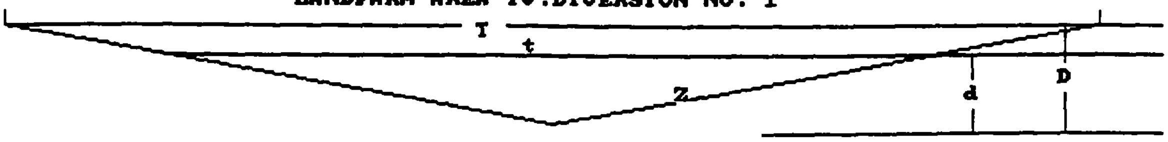
Civil Software Design -- SEDCAD+ Version 3.1

Company Name: GERAGHTY & MILLER, INC.
Filename: C:\SEDCAD3\LF4DIV1 User: R. ISAAC
Date: 08-25-1993 Time: 11:34:15
LANDFARM AREA IV:DIVERSION NO. 1
Storm: 5.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	X
1	1	1	1	-a	1	500.00	5.00	0.57	0.25			
				-b	6	250.00	4.00	3.00	0.02	0.268		

SEDCAD+ CHANNEL DESIGN
LANDFARM AREA IV:DIVERSION NO. 1



MATERIAL: GRASS MIXTURE
Limiting Variable: Velocity = 5.000 fps

				STABILITY CLASS D	CAPACITY CLASS B	w/ FREEBOARD (+ CLASS B)
Discharge	= 8.42 cfs	Depth (d)	=	1.19	1.81	1.81 ft
		Top width (t)	=	7.12	10.84	10.84 ft
Side slopes (Z)	= 3.0:1(L)	Velocity	=	2.09	0.86 fps	
	3.0:1(R)	Hydraulic Radius	=	0.56	0.86 ft	
Bed Slope	= 1.30 %	Manning's n	=	0.055	0.178	
		Froude number	=	0.48	0.16	

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

LANDFARM AREA IV:DIVERSION NO. 2

by

Name: R. ISAAC

Company Name: GERAGHTY & MILLER, INC.
File Name: C:\SEDCAD3\LF4DIV2

Date: 08-25-1993

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: GERAGHTY & MILLER, INC.

Filename: C:\SEDCAD3\LF4DIV2 User: R. ISAAC

Date: 08-25-1993 Time: 11:46:29

LANDFARM AREA IV:DIVERSION NO. 2

Storm: 5.80 inches, 100 year-24 hour, SCS Type II

Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111 1	2.05	83	M	0.240	0.000	0.000	0.0	0.67	6.13
	Type: Null		Label: LF4DIV2						
111 Structure	2.05							0.67	
111 Total IN/OUT	2.05							0.67	6.13

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: GERAGHTY & MILLER, INC.
Filename: C:\SEDCAD3\LF4DIV2 User: R. ISAAC
Date: 08-25-1993 Time: 11:46:29
LANDFARM AREA IV:DIVERSION NO. 2
Storm: 5.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	X
1	1	1	1	-a	1	450.00	5.56	0.60	0.21			
				-b	6	300.00	3.33	2.74	0.03	0.240		

SEDCAD+ VEGETATED CHANNEL DESIGN

LANDFARM AREA IV:DIVERSION NO. 2

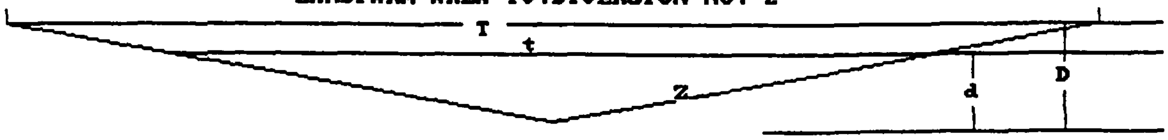
INPUT VALUES:

Shape	TRIANGULAR	
Discharge	6.13 cfs	
Slope	3.30 %	
Sideslopes	3.00:1 (L)	3.00:1 (R)
Max. Velocity	5.000fps	
Material	GRASS MIXTURE	
Freeboard	Max(ft, %)	

RESULTS:

	STABILITY CLASS D	CAPACITY CLASS B	W/ FREEBOARD
Actual Discharge	6.04	5.86 cfs	
Depth	0.87	1.35	1.35 ft
Top Width	5.23	8.09	8.09 ft
Velocity	2.65	1.07 fps	
Cross Sectional Area	2.28	5.46 sq ft	
Hydraulic Radius	0.41	0.64 ft	
Manning's n	0.057	0.187	
Froude Number	0.71	0.23	

SEDCAD+ CHANNEL DESIGN
LANDFARM AREA IV:DIVERSION NO. 2



MATERIAL: GRASS MIXTURE
Limiting Variable: Velocity = 5.000 fps

Discharge = 5.86 cfs
Side slopes (Z) = 3.0:1(L)
3.0:1(R)
Bed Slope = 3.30 %

		STABILITY CLASS D	CAPACITY CLASS B	w/ FREEBOARD (+ CLASS B)
Depth (d)	=	0.87	1.35	1.35 ft
Top width (t)	=	5.23	8.09	8.09 ft
Velocity	=	2.65	1.07 fps	
Hydraulic Radius	=	0.41	0.64 ft	
Manning's n	=	0.057	0.187	
Froude number	=	0.71	0.23	

APPENDIX D

CLOSURE COST ESTIMATE

GERAGHTY & MILLER, INC.
Environmental Services

SUBJECT: OPINION OF PROBABLE CLOSURE COST
PROJECT: UNO-VEN LANDFARM CLOSURE PLAN
CLIENT/PROJECT NO: CI0264.002

BY: RAI DATE: 6/10/93
CHKD: DATE:
REV: RAI DATE: 8/24/93

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The following calculations are for the opinion of probable cost for providing closure activities.

1) Clearing and Grubbing

Means Site Work and Landscape 021-108-0300

Approximately 2.0 acres
Cost · 2acres x $725/ac = $1450

2) Site Grading

Grade the site in order to establish a subbase upon which the soil cover will be constructed; for purposes of determining a cost assume to grade approximately 1-foot over the landfarm acreage of 13.5 acres.

Volume - 13.5 acres x 43560 SF/ac x 1FT x 1CY/27CF = 21780 CY

Means Site Work and Land Scape 022-262-0010

Cost - $1.33/CY x 21780 CY = $28,967.40 use $29,000

3) Common Borrow

Material to be obtained from an off-site source, stockpiled on-site and used to construct the soil cover layer; for purposes of determining the cost of common borrow required to construct the final cover system use 2.5 feet of material over the 13.5 acres plus 50% of the total volume (cubic yards) for establishing the 4% percent grade and 3:1 slopes.

Volume - 13.5 acs x 43560 SF/ac x 2.5 FT x 1CY/27CF = 54450 CY
54450 CY + (54450 CY x 0.50) = 81675 CY

Kimbal Limestone Co.

Cost of material and delivery - $4.00/CY
Material will be delivered to the site and stockpiled for future use in construction activities

Means Site Work and Landscape

Load material from stockpile to truck:
022-216-4070 Common earth, front end loader, wheel-mounted, 3 CY bucket - $4.46/CY
022-266-0310 Hauling, 12 CY dump truck, 1/4 mile round trip: $1.87/CY
Material to be dumped and spread
022-208-3220 Spread with 105 HP Dozer, 105 FT push, common earth - $1.42/CY
Material to be compacted in a controlled fill situation
022-266-6060 Towed sheepsfoot roller, 12" lifts, 3 passes - $0.32/CY

Total Cost of Common Borrow:

Material & Delivery	$4.00
Load from Stockpile	4.46
Haul to Area	1.87
Spread	1.42
Compaction	0.32
Total	$12.07/CY

TOTAL COST - $12.07/CY x 81675 CY = $985,817.25 use $985,800

GERAGHTY & MILLER, INC.
Environmental Services

SUBJECT: OPINION OF PROBABLE CLOSURE COST
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4) Seeding & Mulching
Use hydroseeding at \$0.30/SY
Volume 13.5 acs x 43560 SF/ac x 1SY/9SF = 65340SY
Cost - \$0.30/SY x 65340SY = \$19,602 use \$19,600

APPENDIX E

CLOSURE CERTIFICATION STATEMENT

CLOSURE PLAN
CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

IL D0041550567	UNO-VEN Refinery, Lemont, Illinois
USEPA ID Number	Facility Name
______________________	______________________
Signature of Owner/Operator	Name and Title
______________________	
Date	